

FIG. 1A

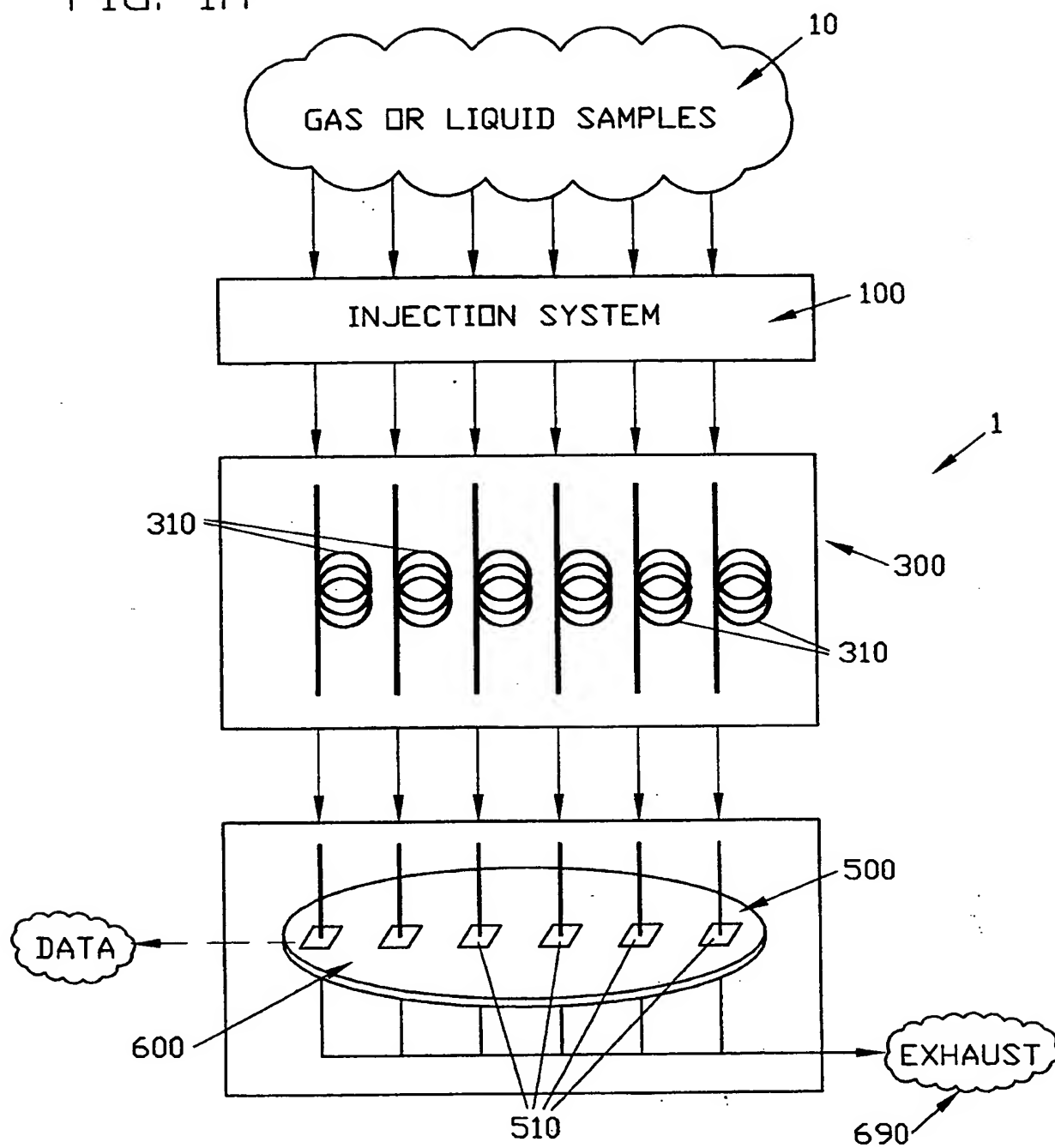
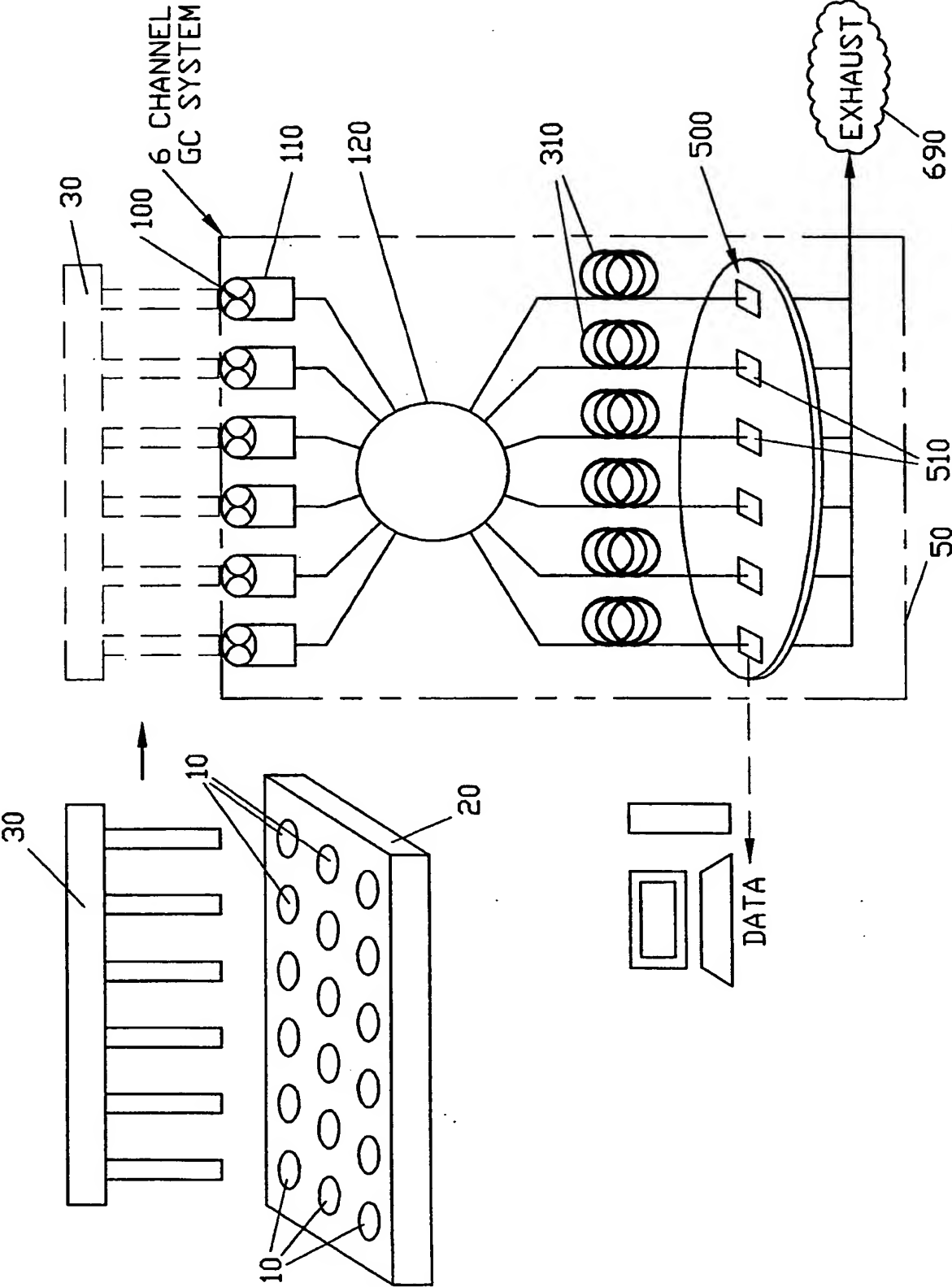
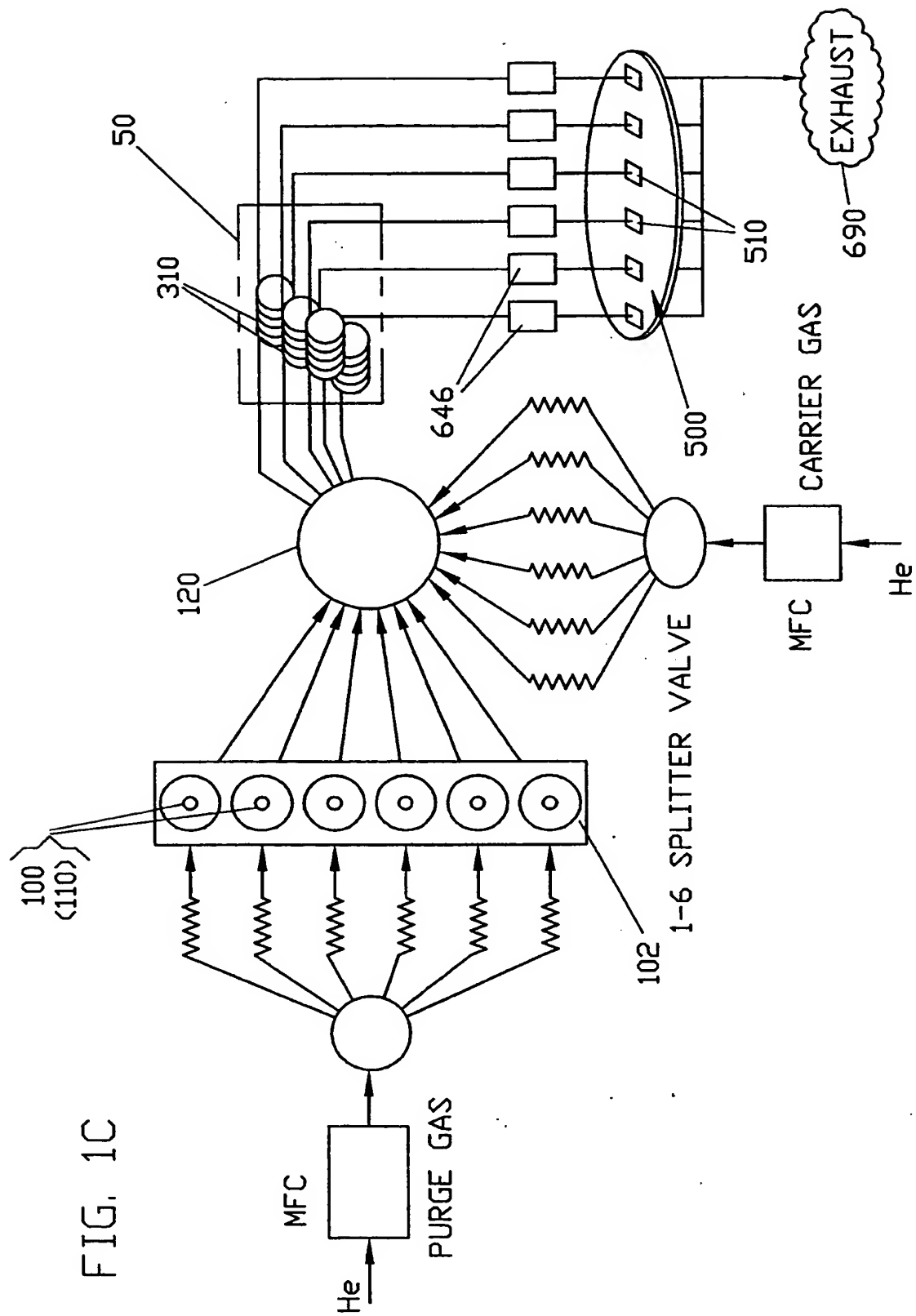
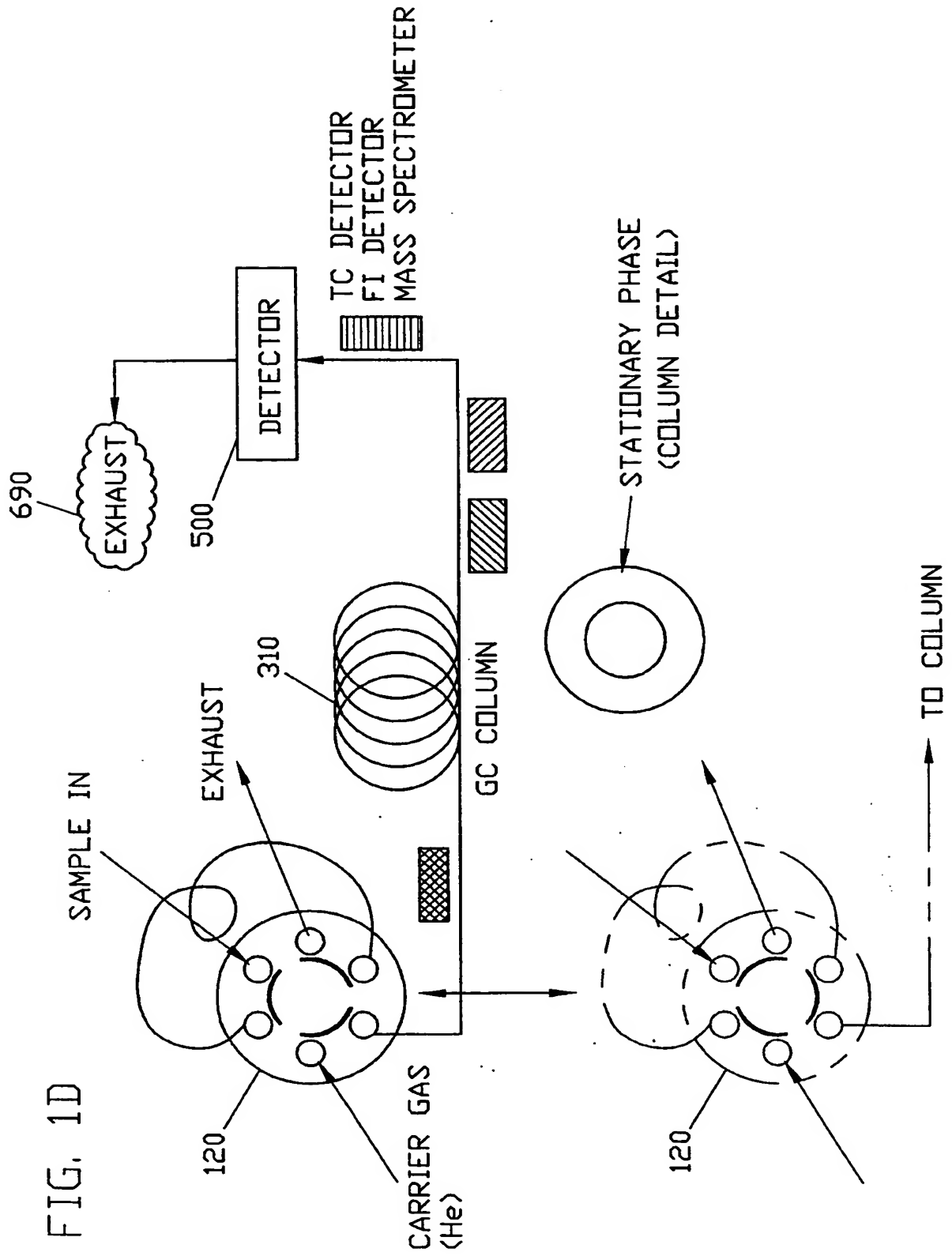


FIG. 1B







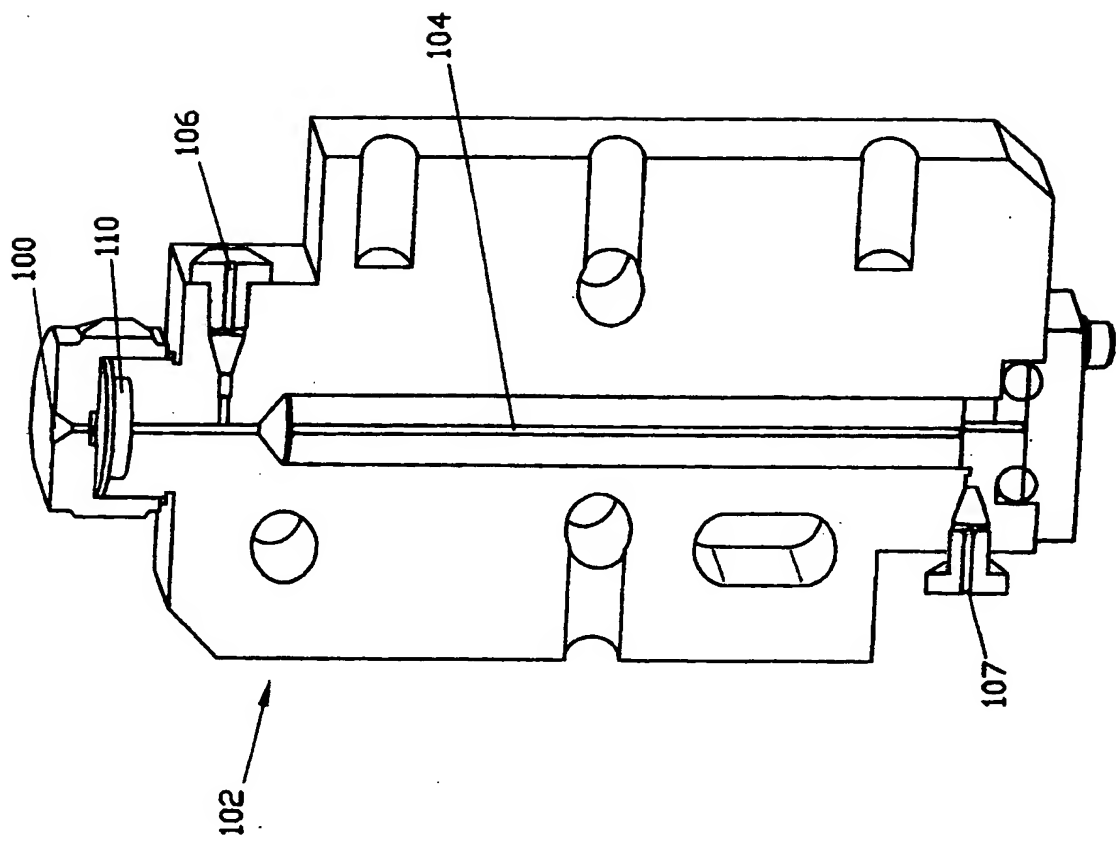


FIG. 2A

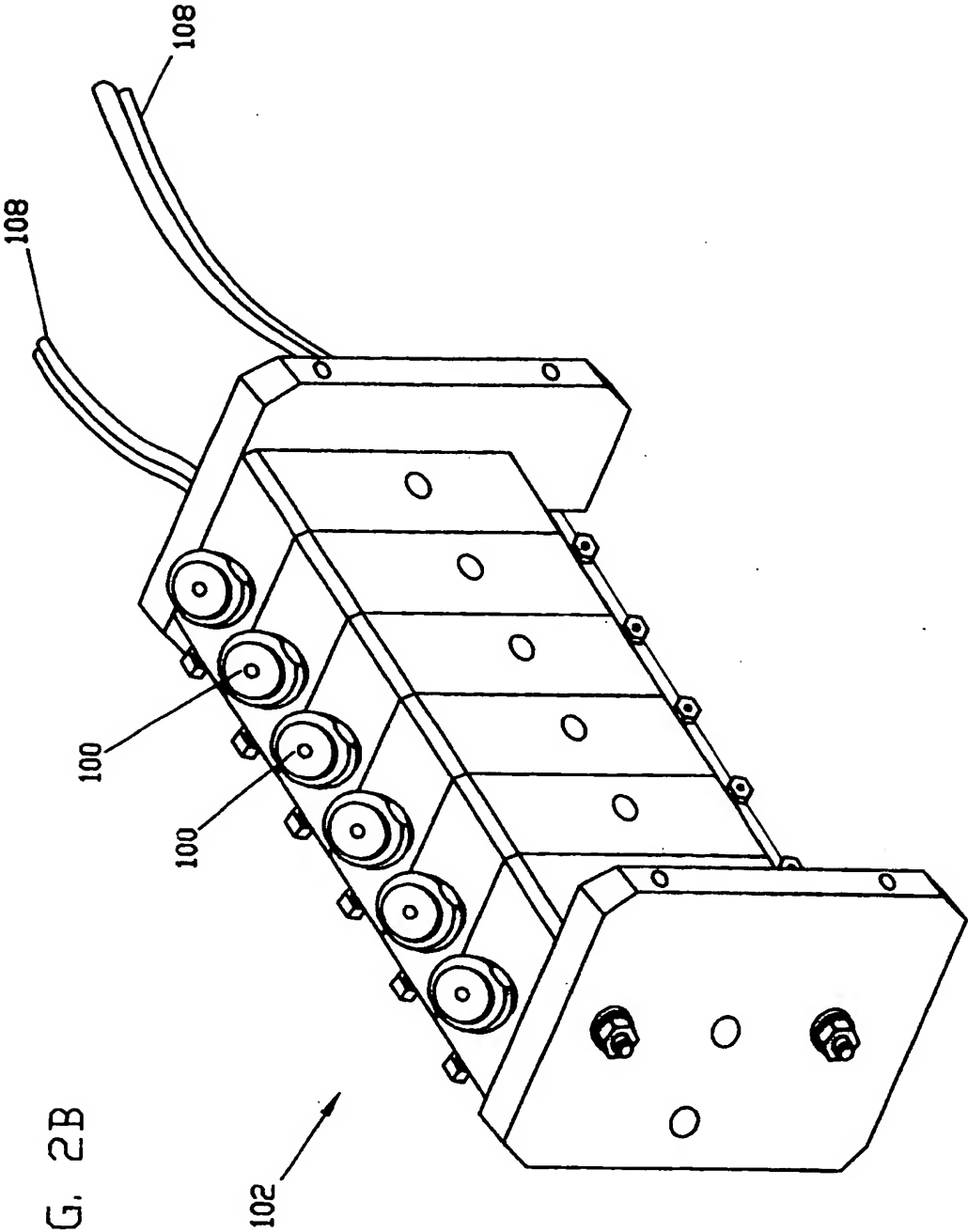


FIG. 2B

FIG. 2C

INJECTION PORT CROSS SECTION

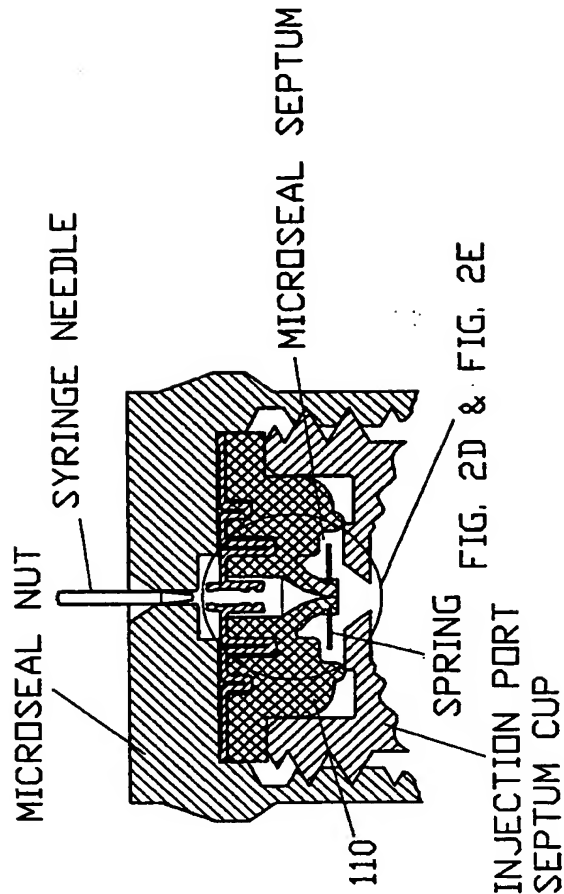


FIG. 2D

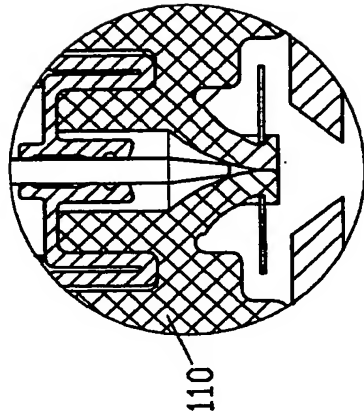
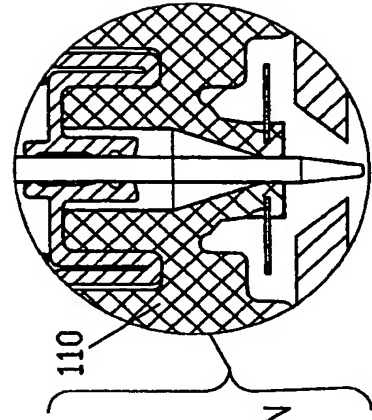


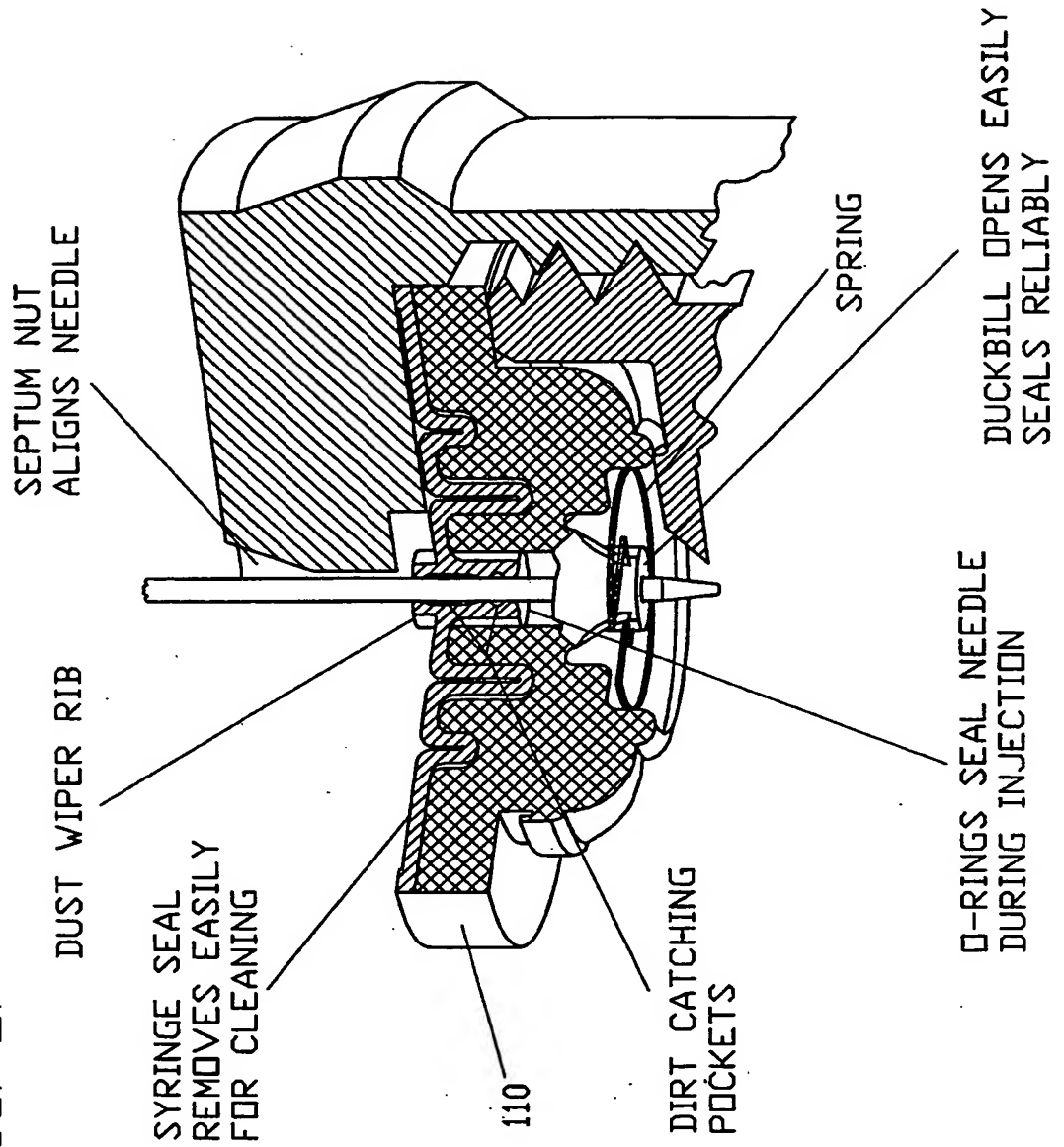
FIG. 2E



## INJECTION SEQUENCE

1. SLIDING SEAL IS MADE AROUND NEEDLE AS IT IS INSERTED
2. SYRINGE NEEDLE FORCES DUCKBILL LIPS TO OPEN
3. SAMPLE INJECTED
4. SPRING FORCES DUCKBILL CLOSED AS NEEDLE IS WITHDRAWN
5. NEEDLE IS REMOVED FROM SLIDING SEAL

FIG. 2F





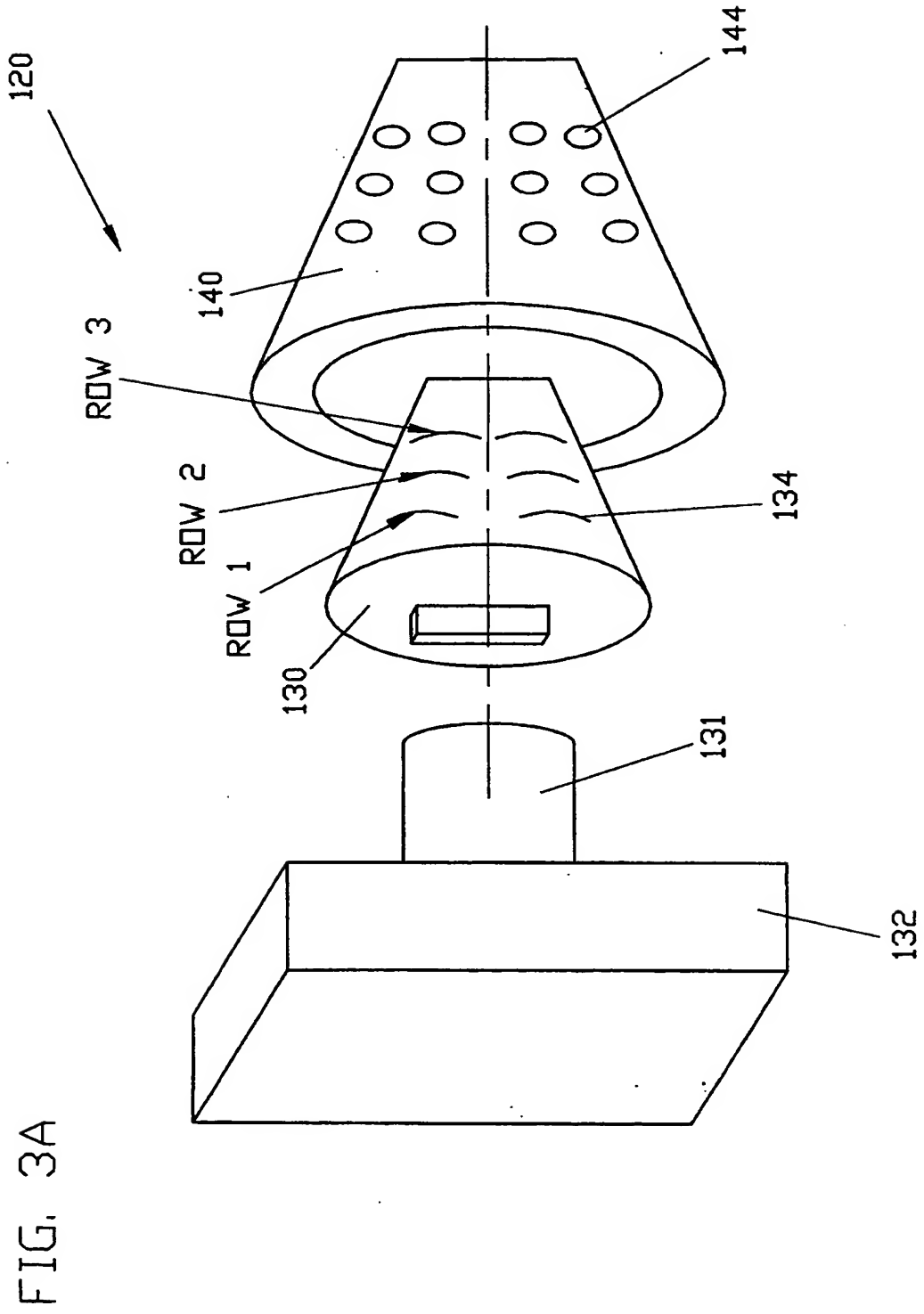


FIG. 3B

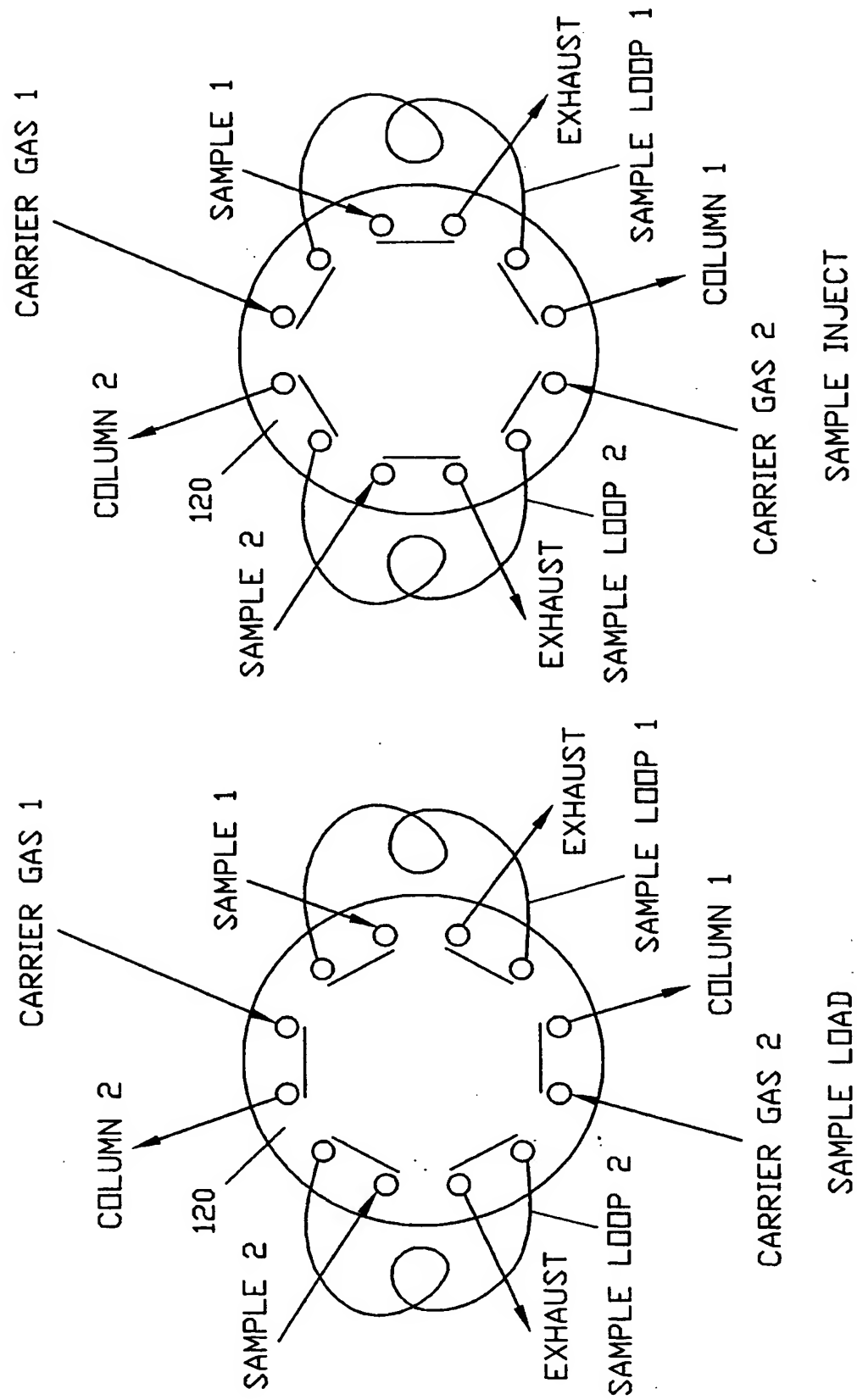
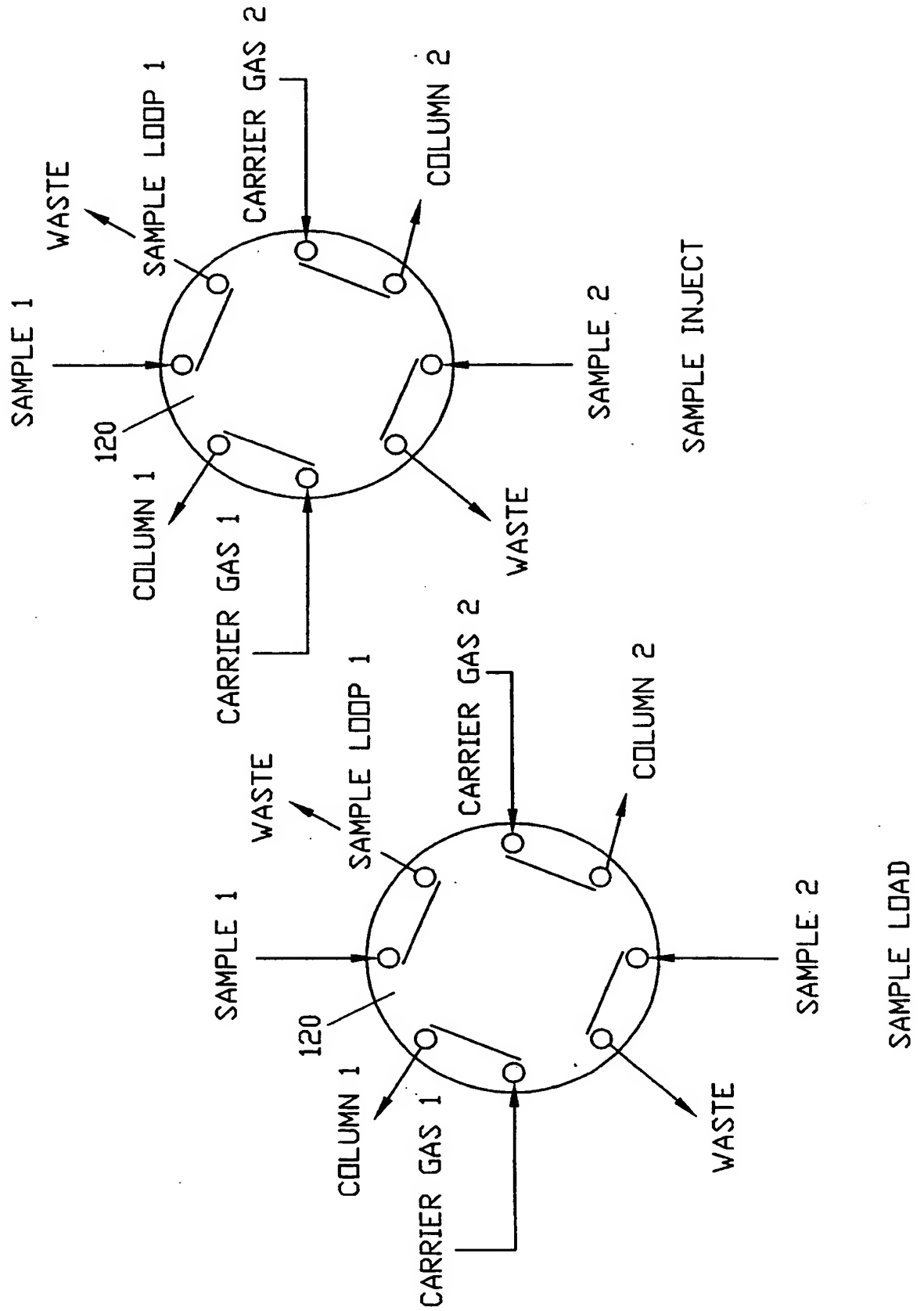
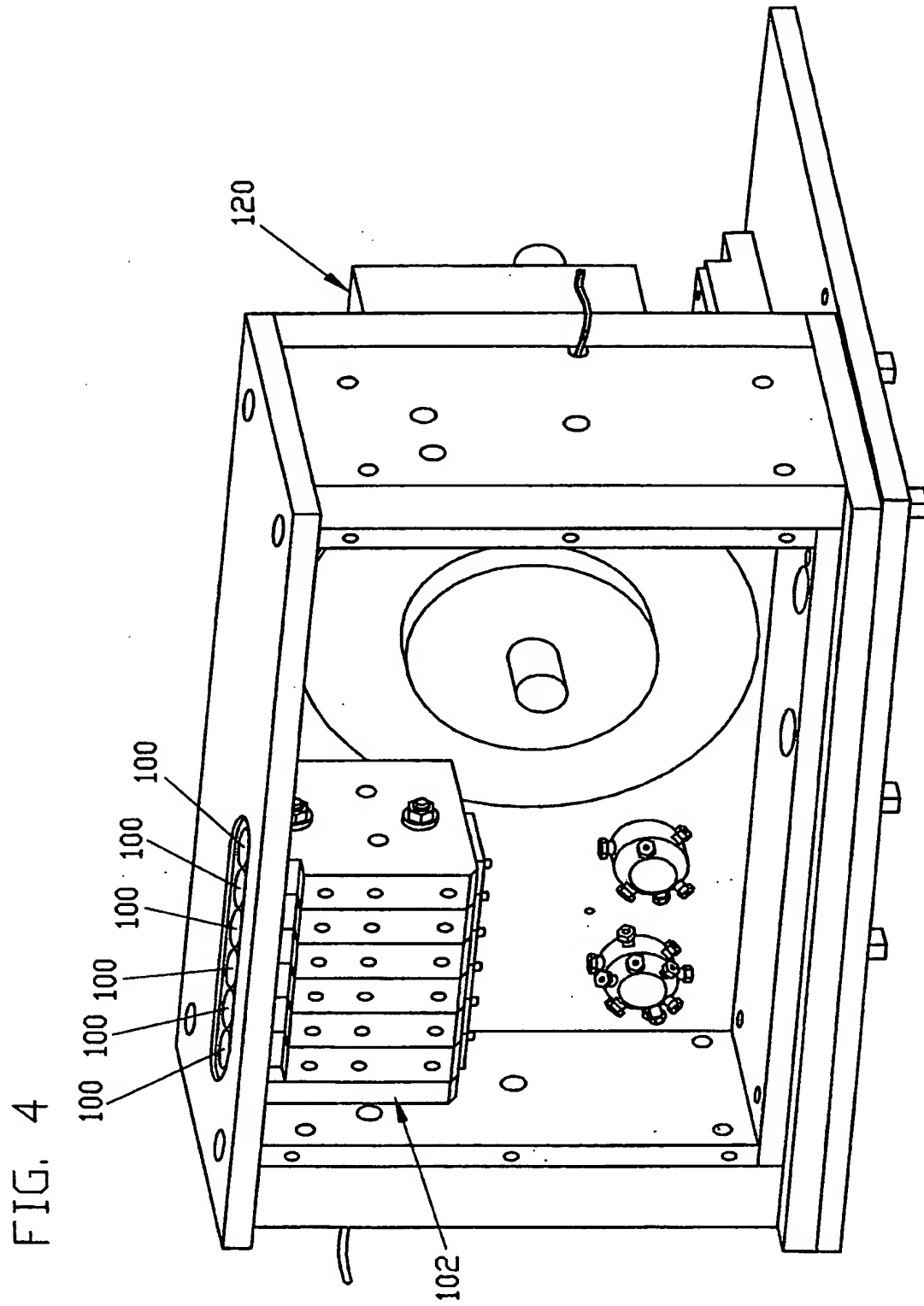


FIG. 3C





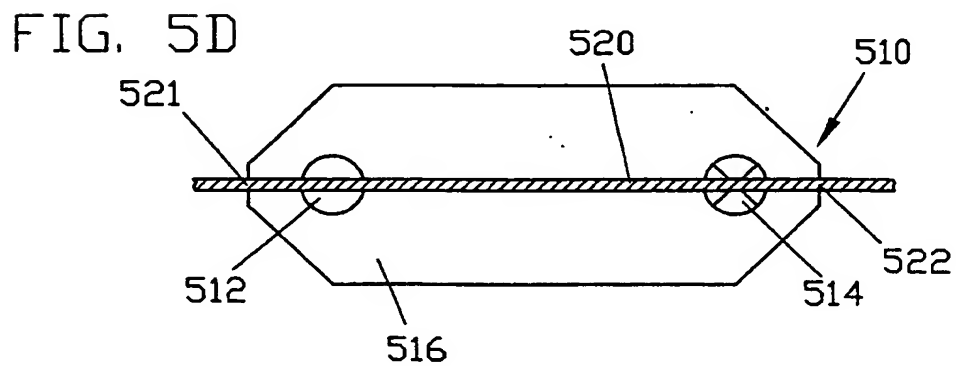
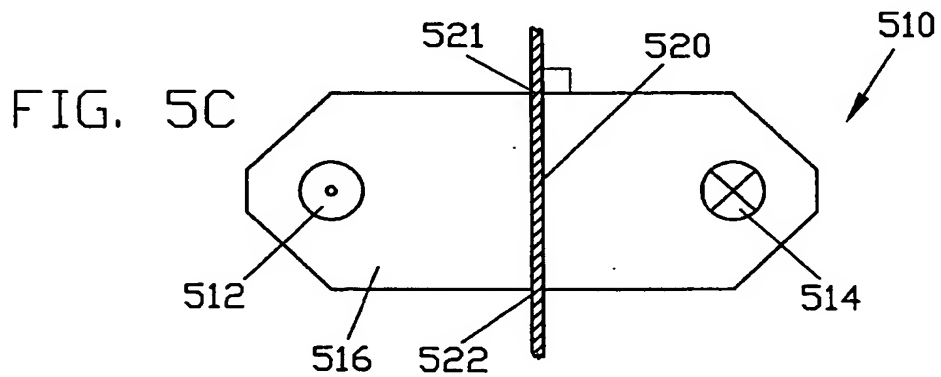
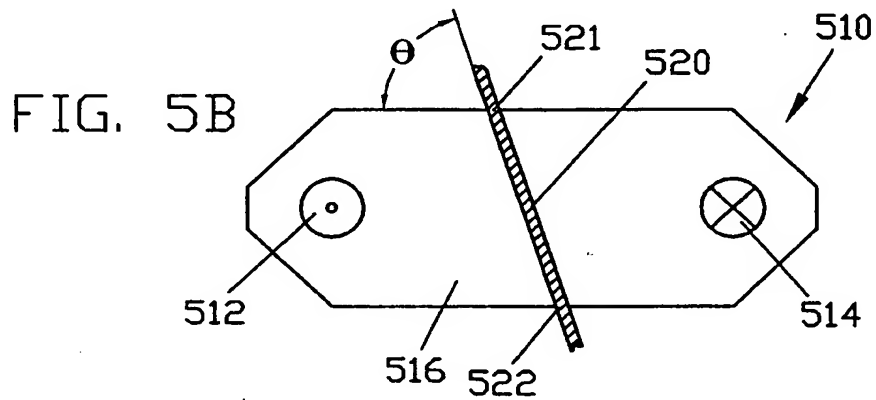
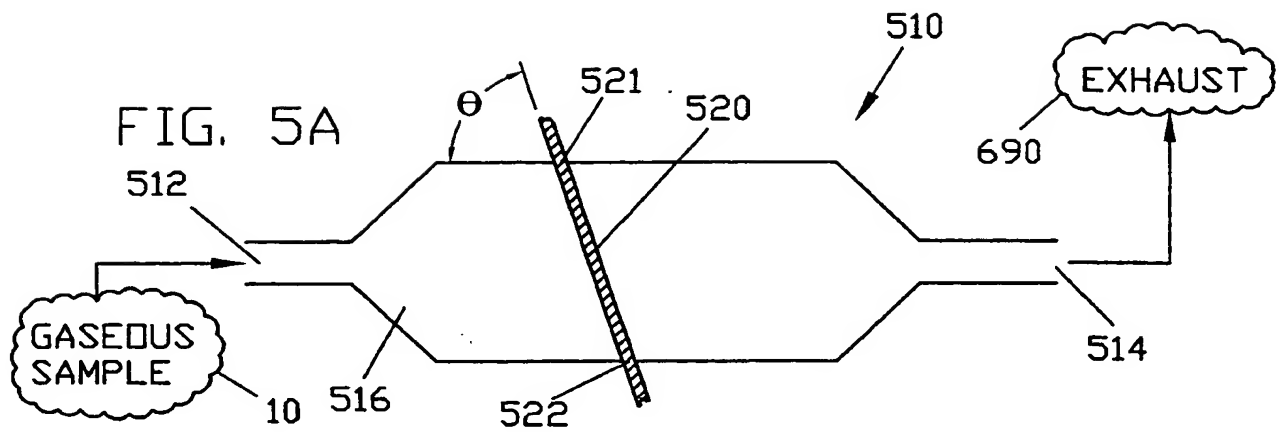


FIG. 5E

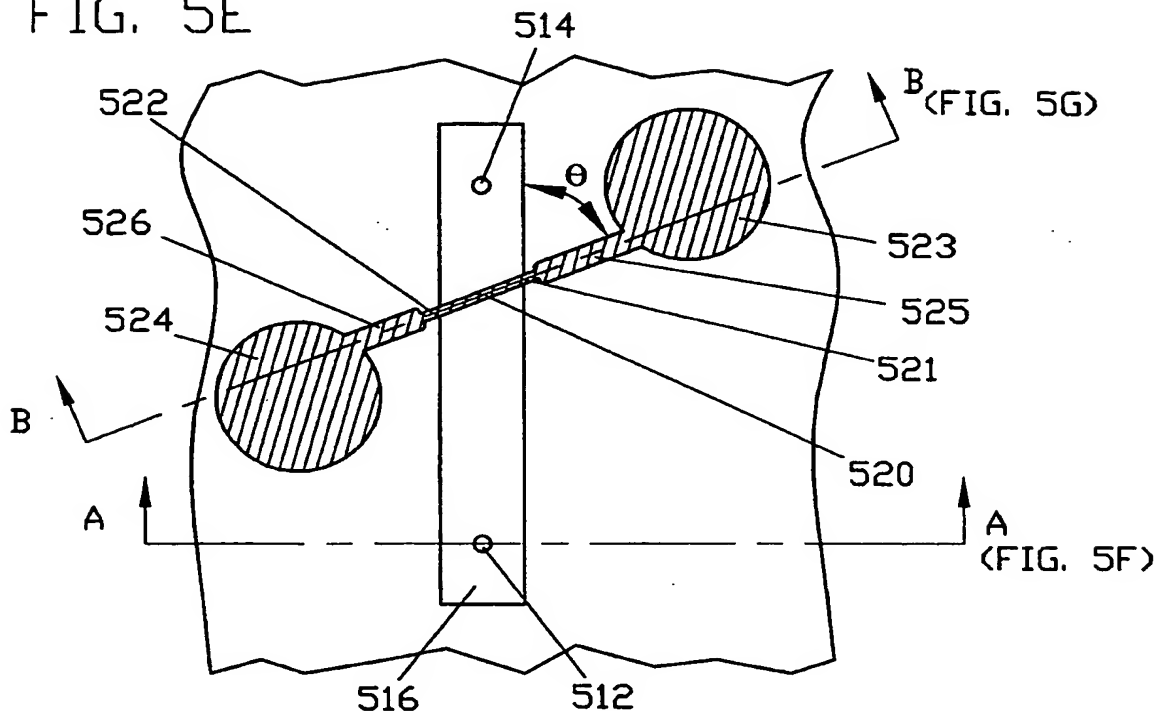


FIG. 5F

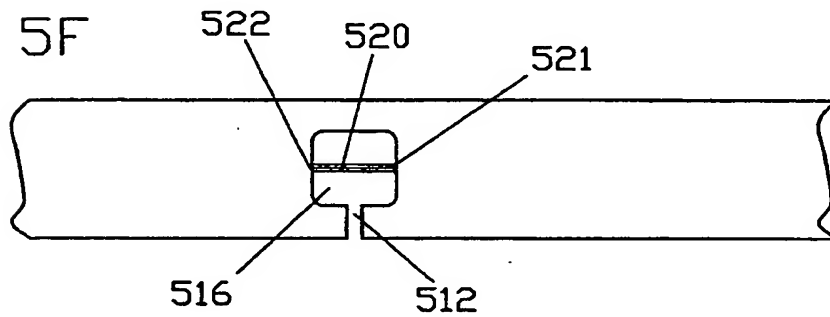


FIG. 5G

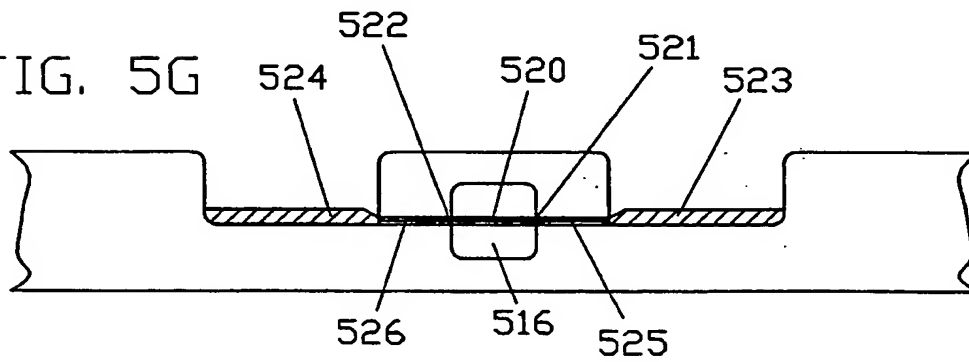


FIG. 5I

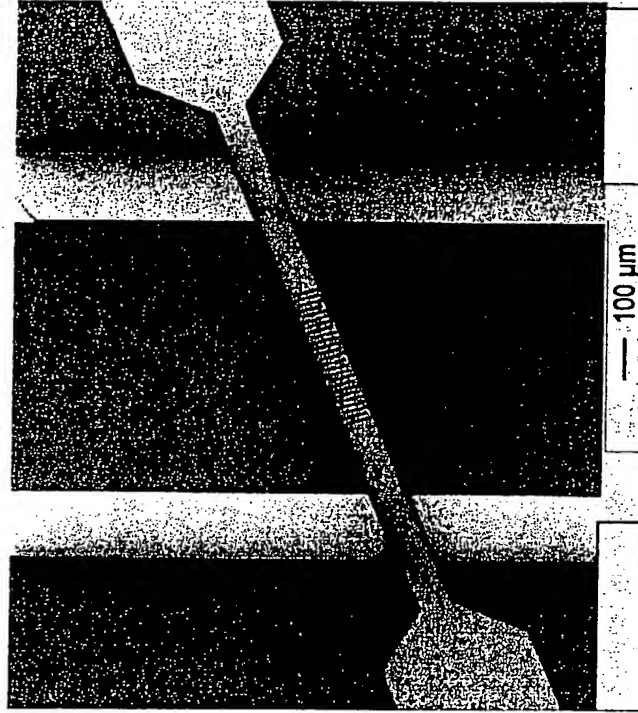


FIG 5H.

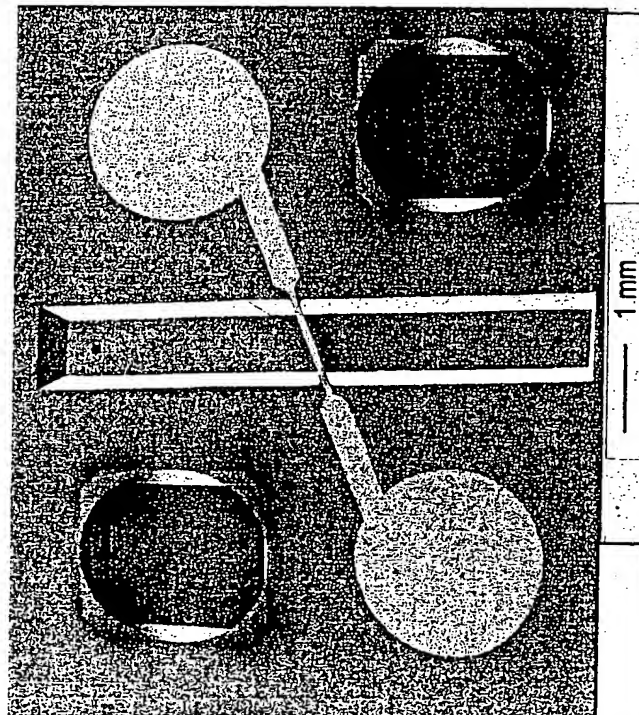
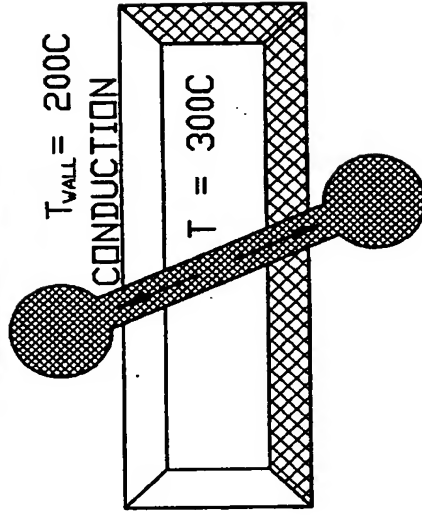


FIG. 5J

# HEAT TRANSFER CALCULATIONS FOR TDC DESIGN



\*CONDUCTION VIA LEADS TO FRAME

$$Q_{\text{conduction}} = \frac{k}{L} * A * \Delta T$$

$$Q_{\text{conduction}} \sim 0.2\text{mW}$$

\*RADIATION

$$Q_{\text{radiation}} = \epsilon * \sigma * A * (T_{\text{hot}}^4 - T_{\text{ambient}}^4)$$

$$Q_{\text{radiation}} = 1 * (5.67 * 10^{-8}) * (52\mu\text{m} * 1.5\text{mm}) * (573^4 - 473^4)$$

$$Q_{\text{radiation}} \approx 0.25\text{mW}$$

\*CONVECTION

\*CONVECTION INTO GAS DOMINATES

$$Q_{\text{convection}} = h * A * \Delta T$$

$$Q_{\text{convection}} = 1000 * (52\mu\text{m} * 1.5\text{mm}) * 100 = 8\text{mW}$$



FIG. 5K

CONVECTION HEAT TRANSFER FOR TDC DESIGN

$$Q_{\text{convection}} = h * A * \Delta T$$

$$h \approx 2 * \frac{k}{D} + \frac{1}{2} * u * p * C_p$$

REQUIRE-

$$2 * \frac{k}{D} \gg \frac{1}{2} * u * p * C_p$$

TDC VS. ANEMOMETER BEHAVIOR

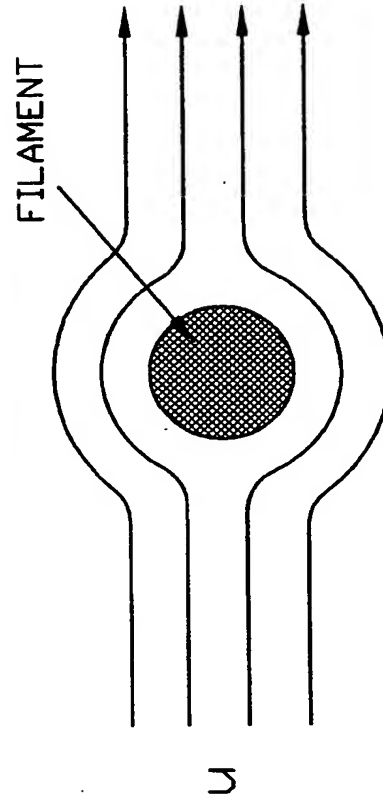


FIG. 5L

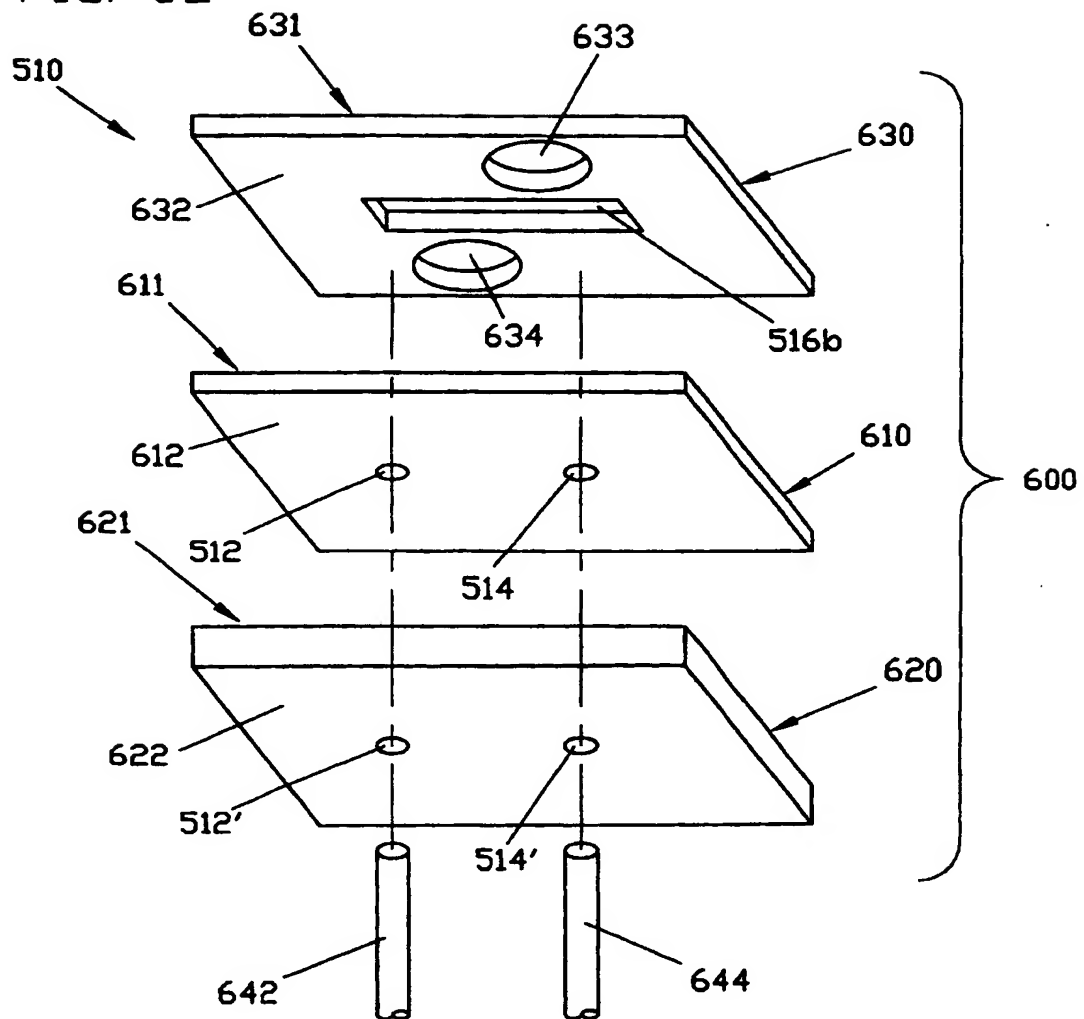


FIG. 5M

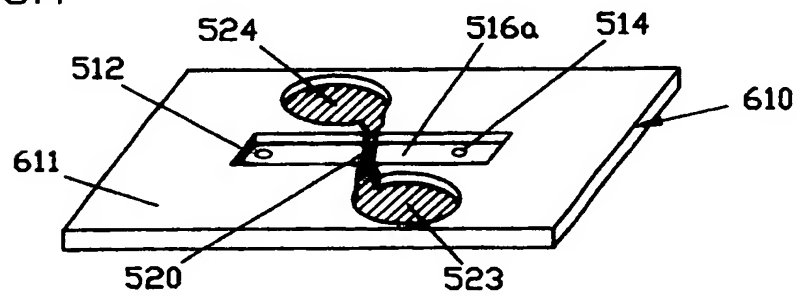


FIG. 6A

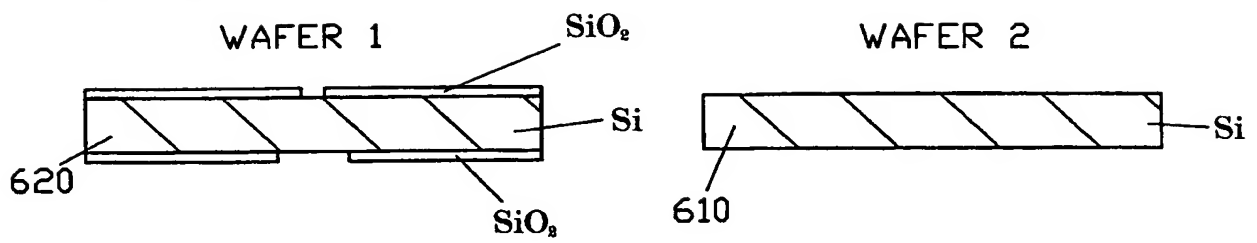


FIG. 6B

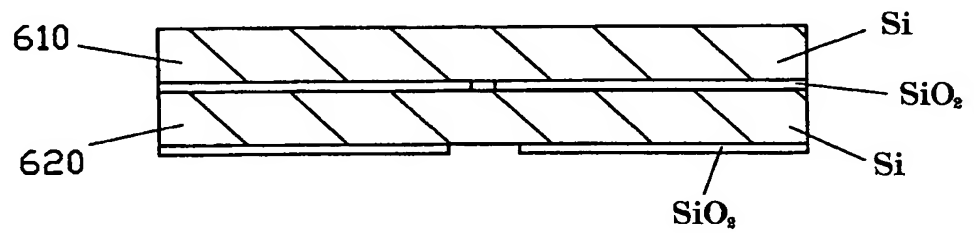


FIG. 6C

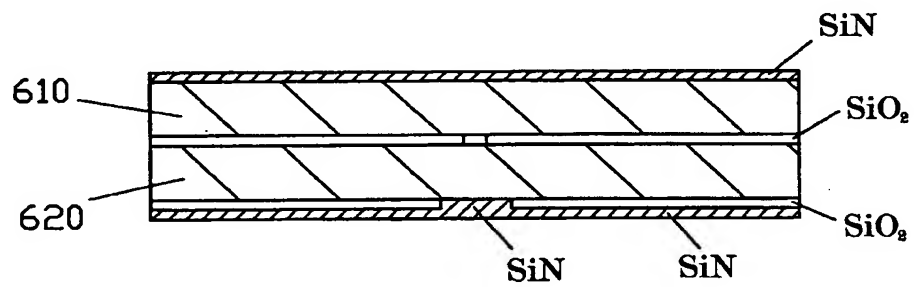


FIG. 6D

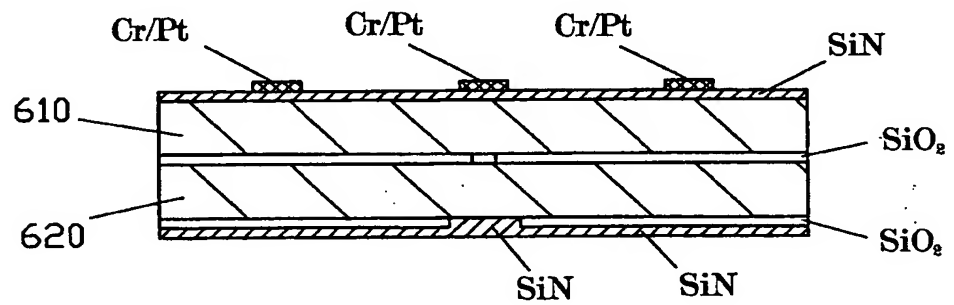


FIG. 6E

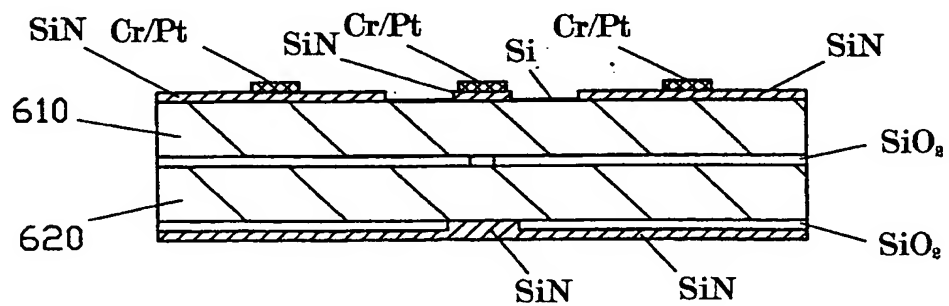


FIG. 6F

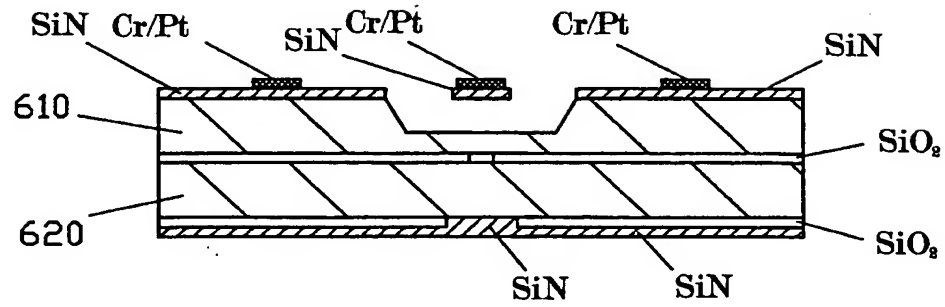


FIG. 6G

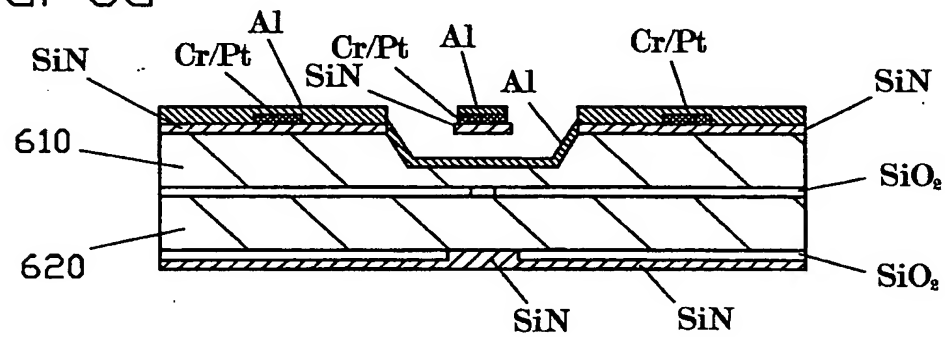


FIG. 6H

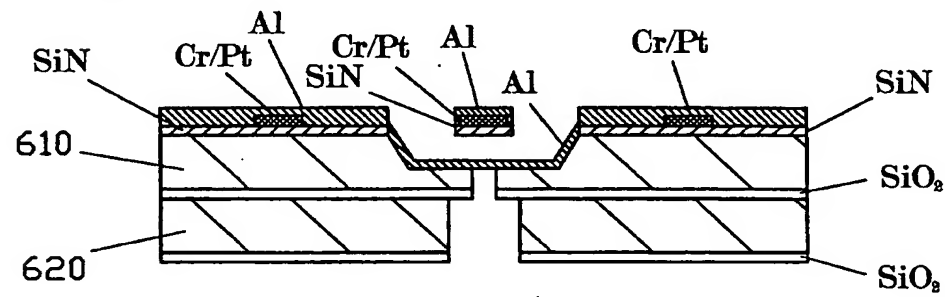
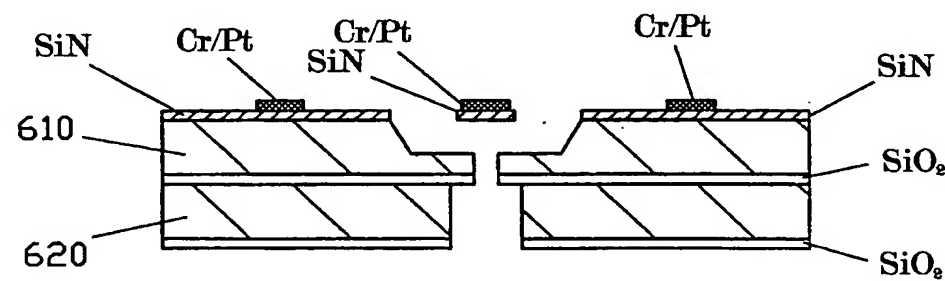


FIG. 6I



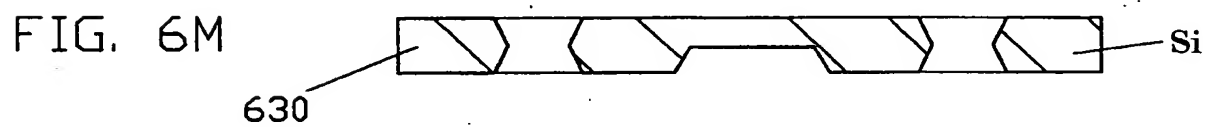
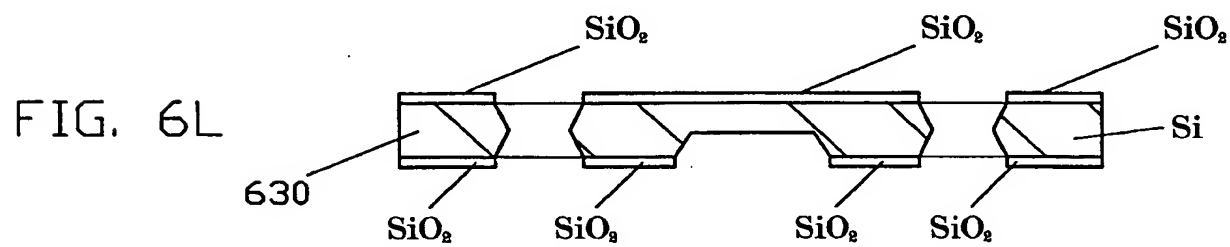
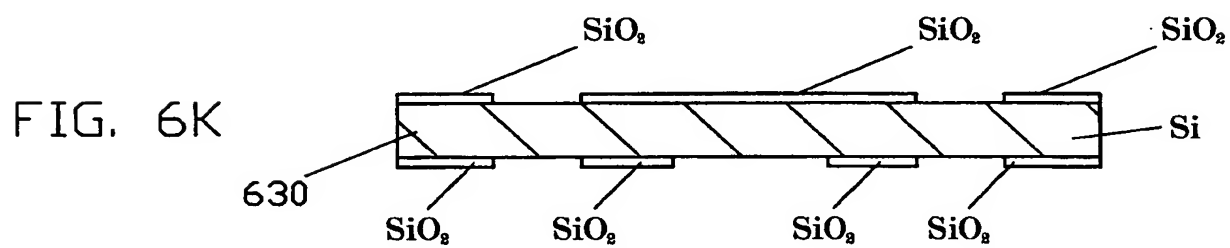
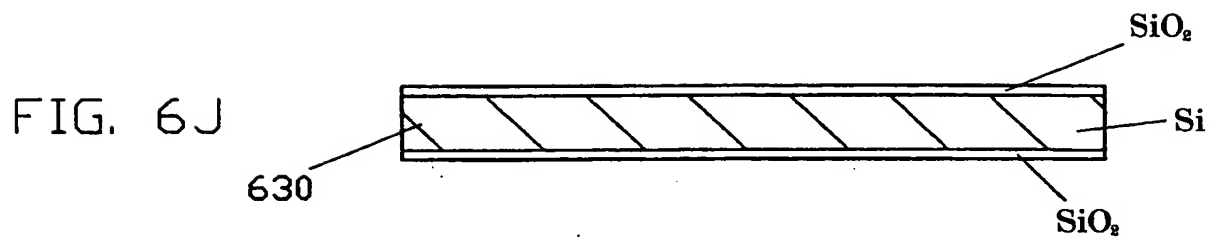


FIG. 6N

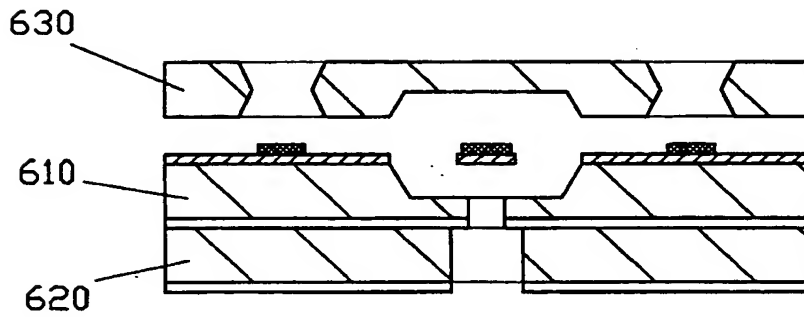


FIG. 6O

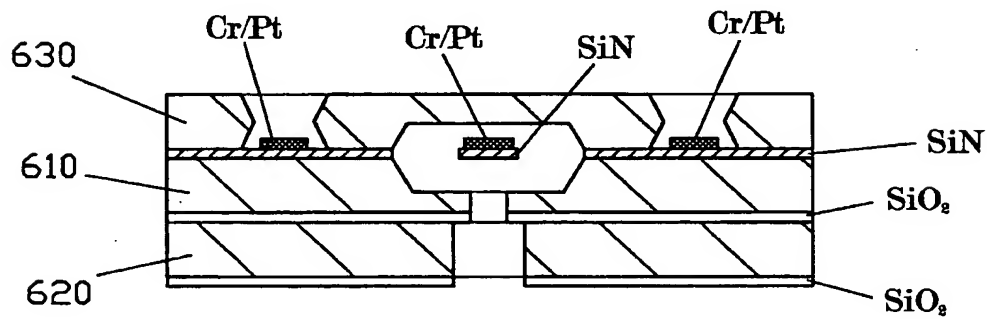


FIG. 6P

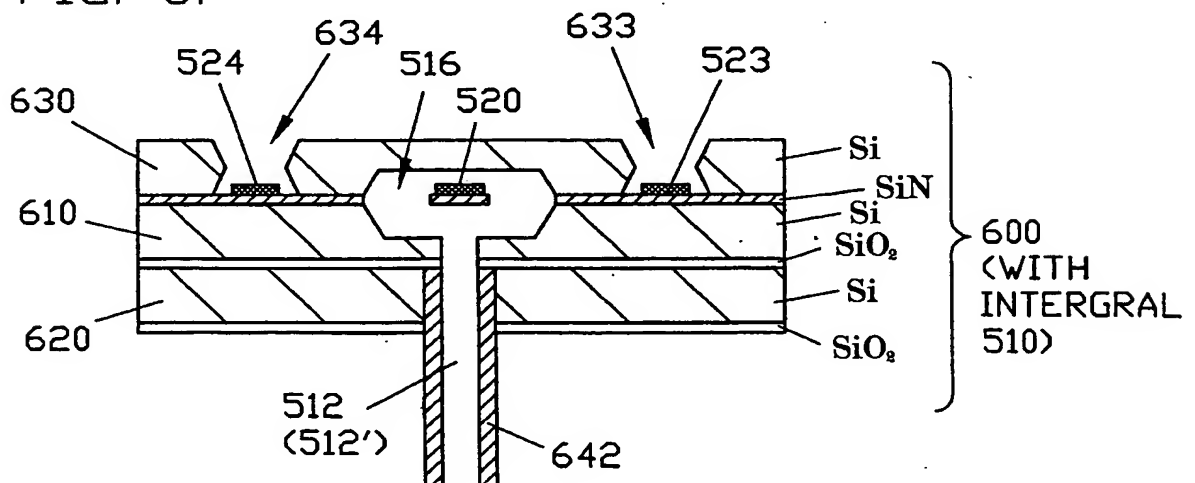


FIG. 7A

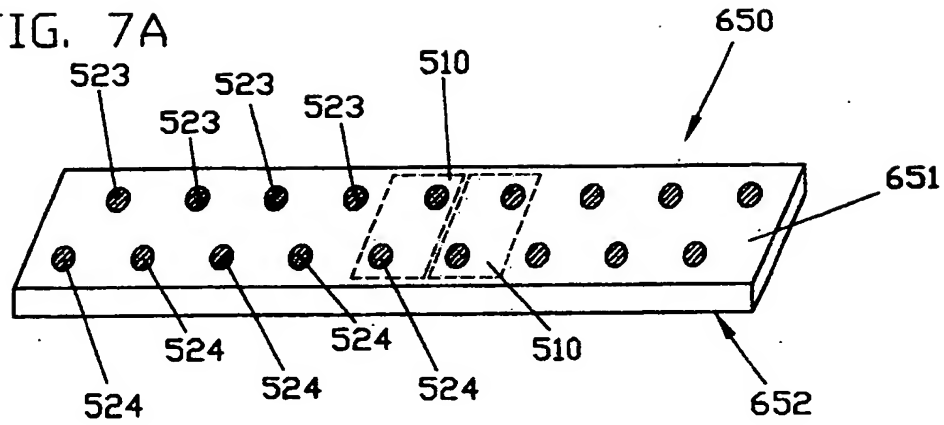


FIG. 7B

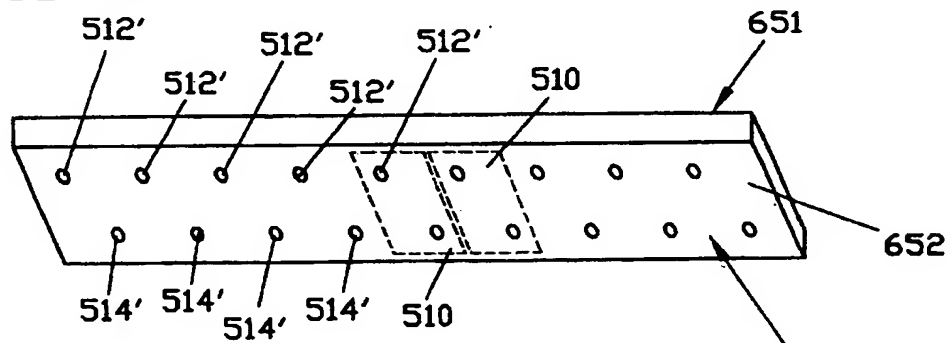


FIG. 7C

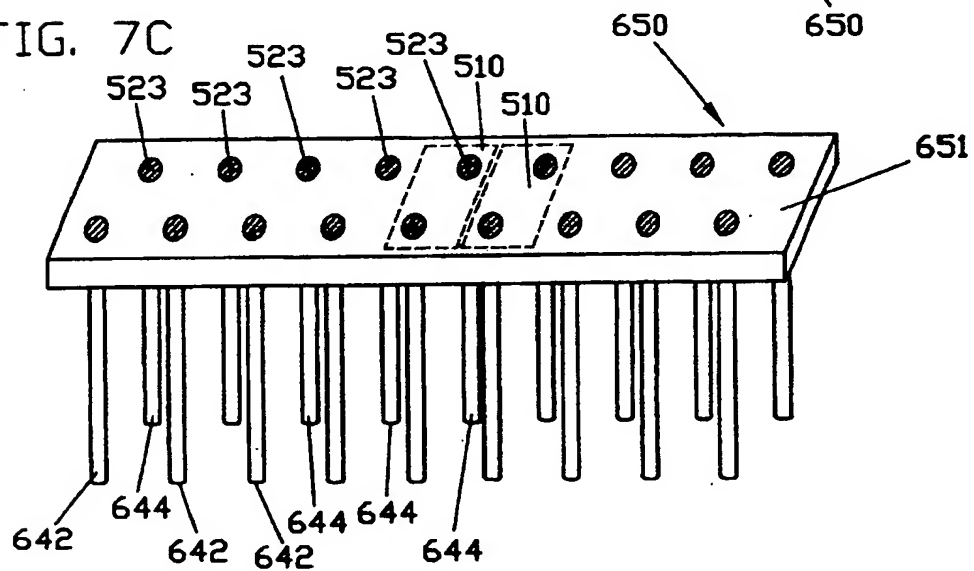


FIG. 7D

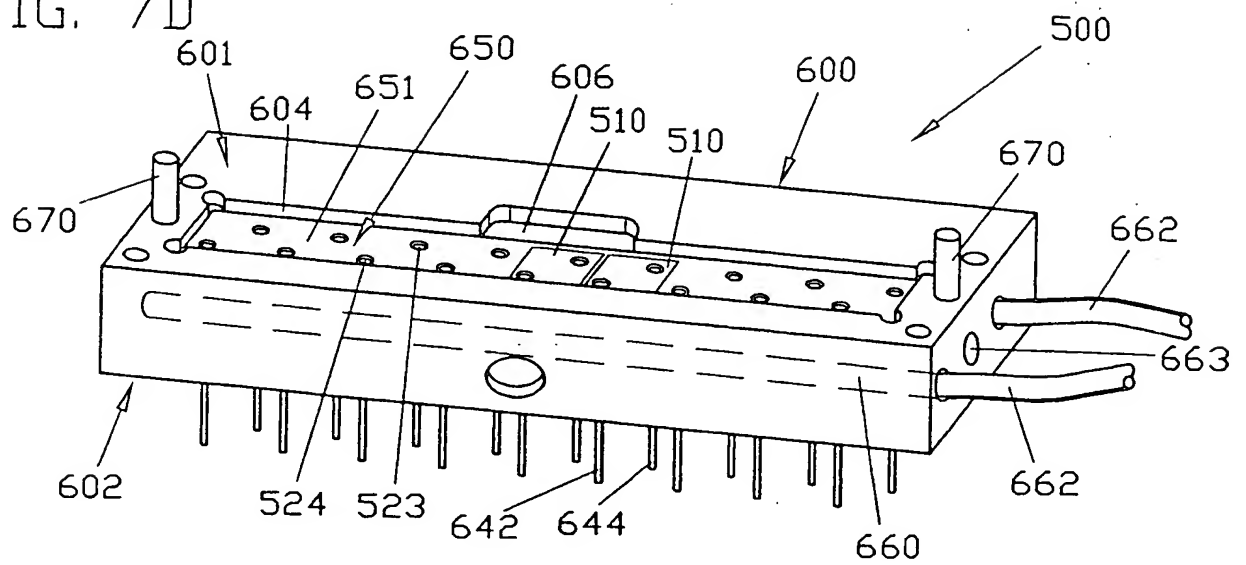


FIG. 7E

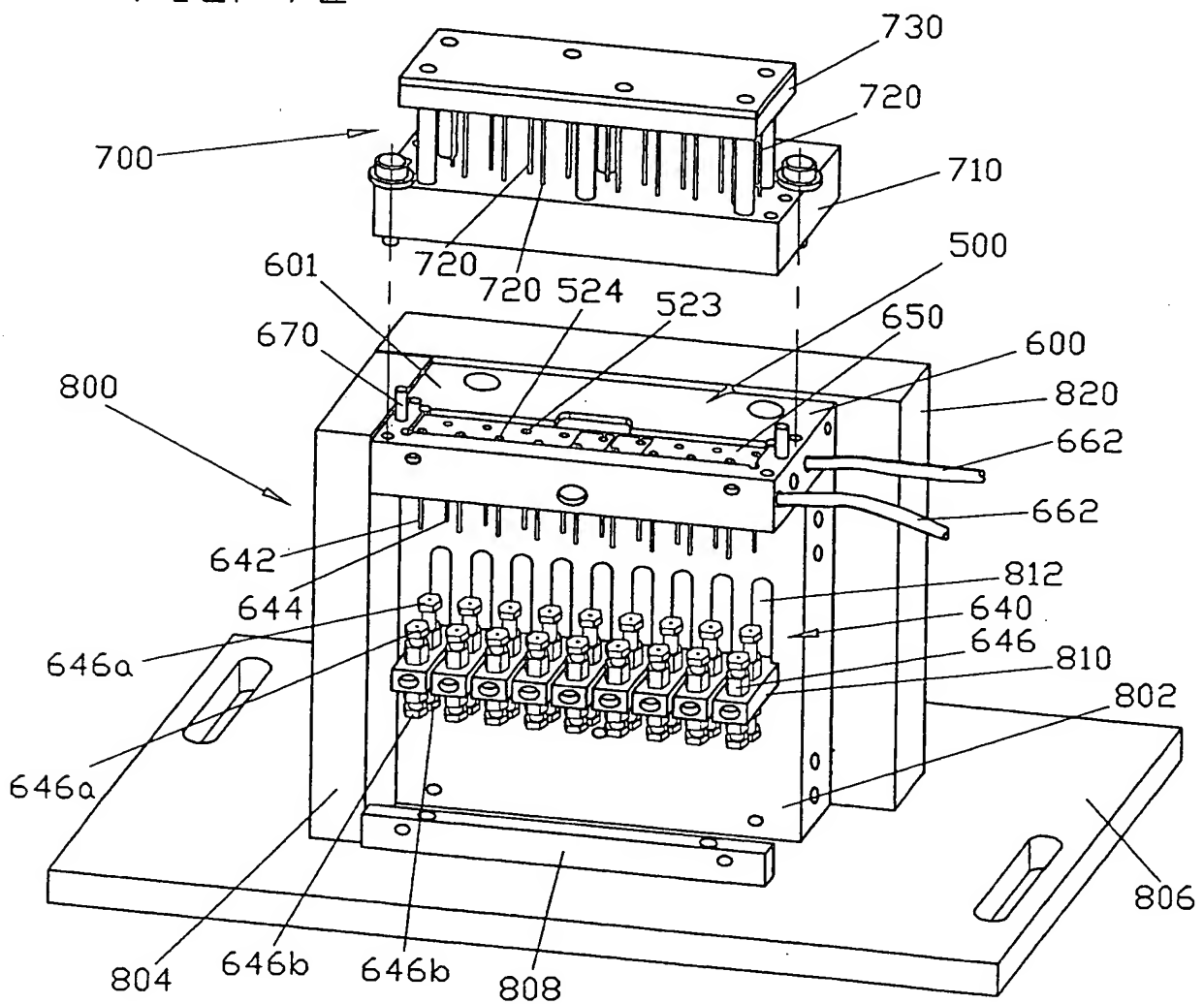




FIG. 7F

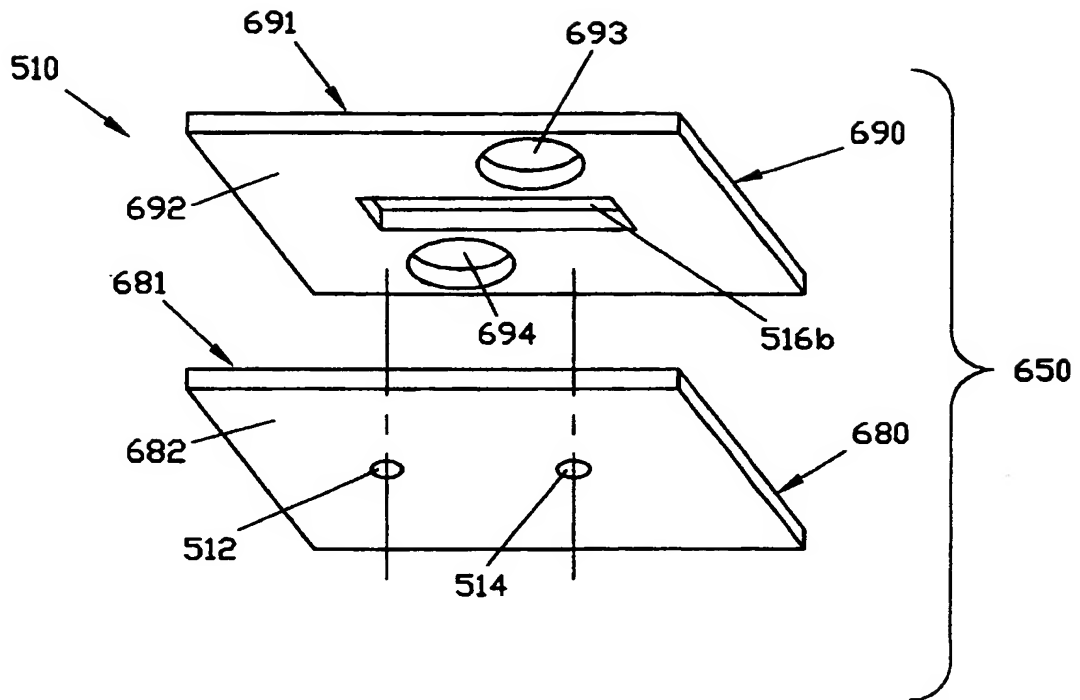


FIG. 7G

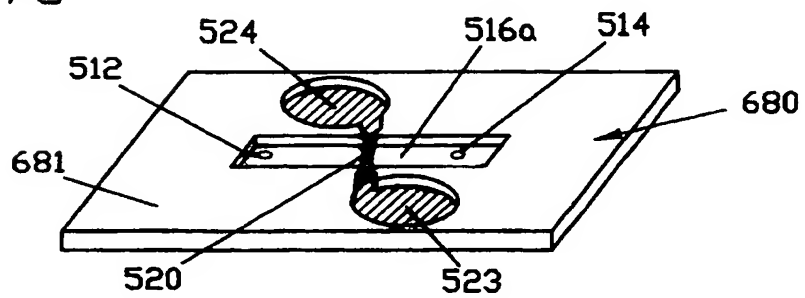


FIG. 7H

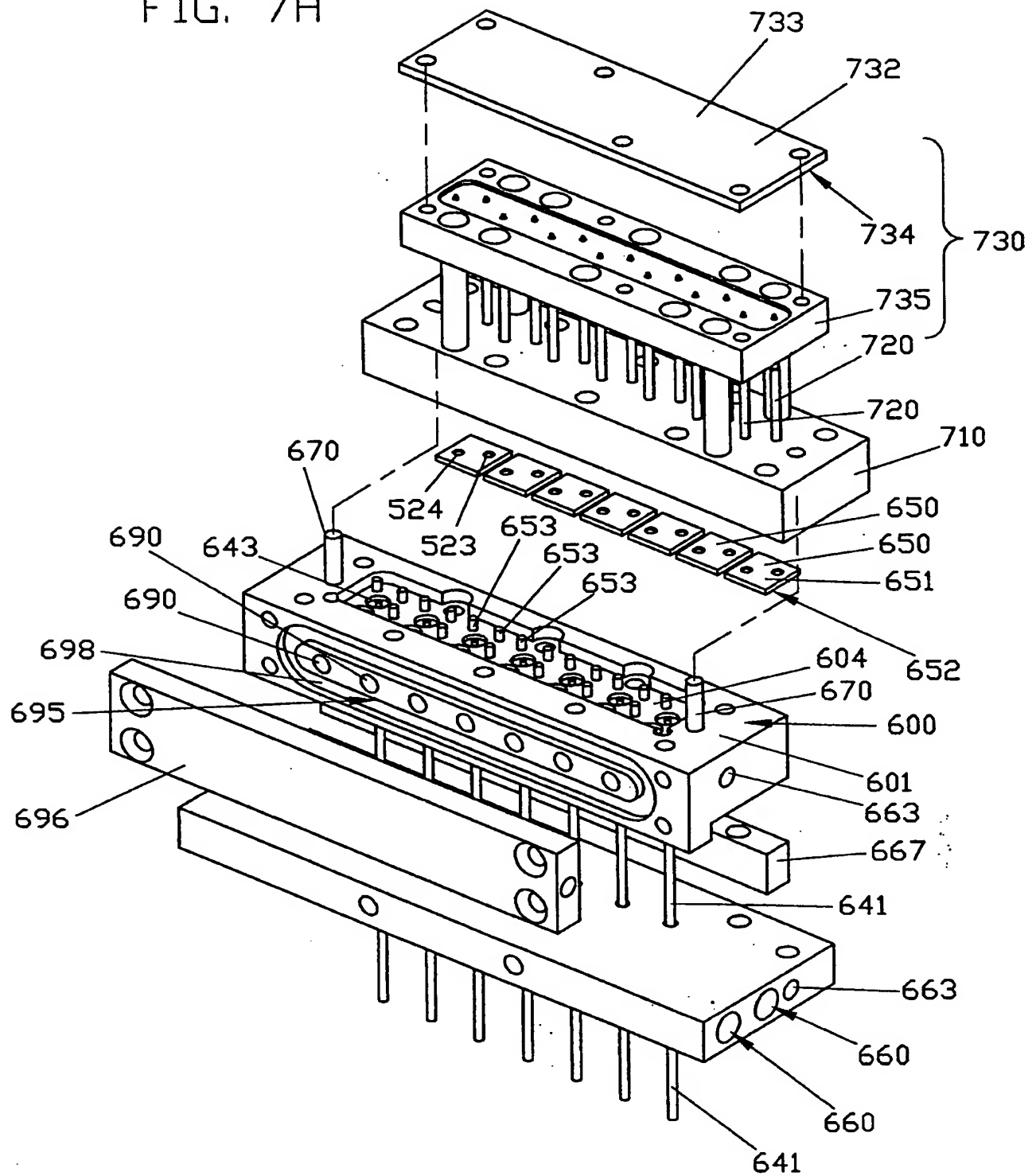


FIG. 7I

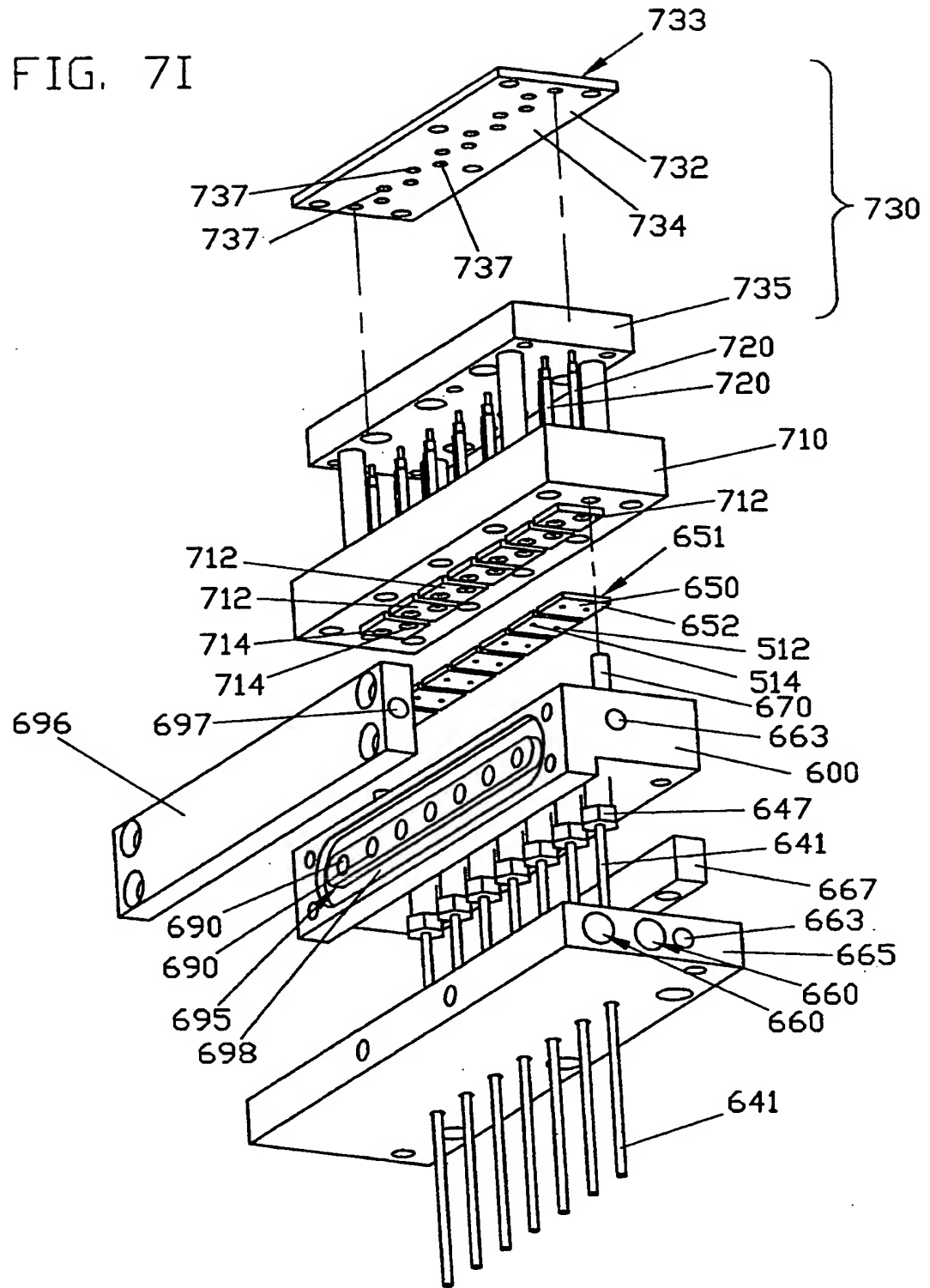


FIG. 7J

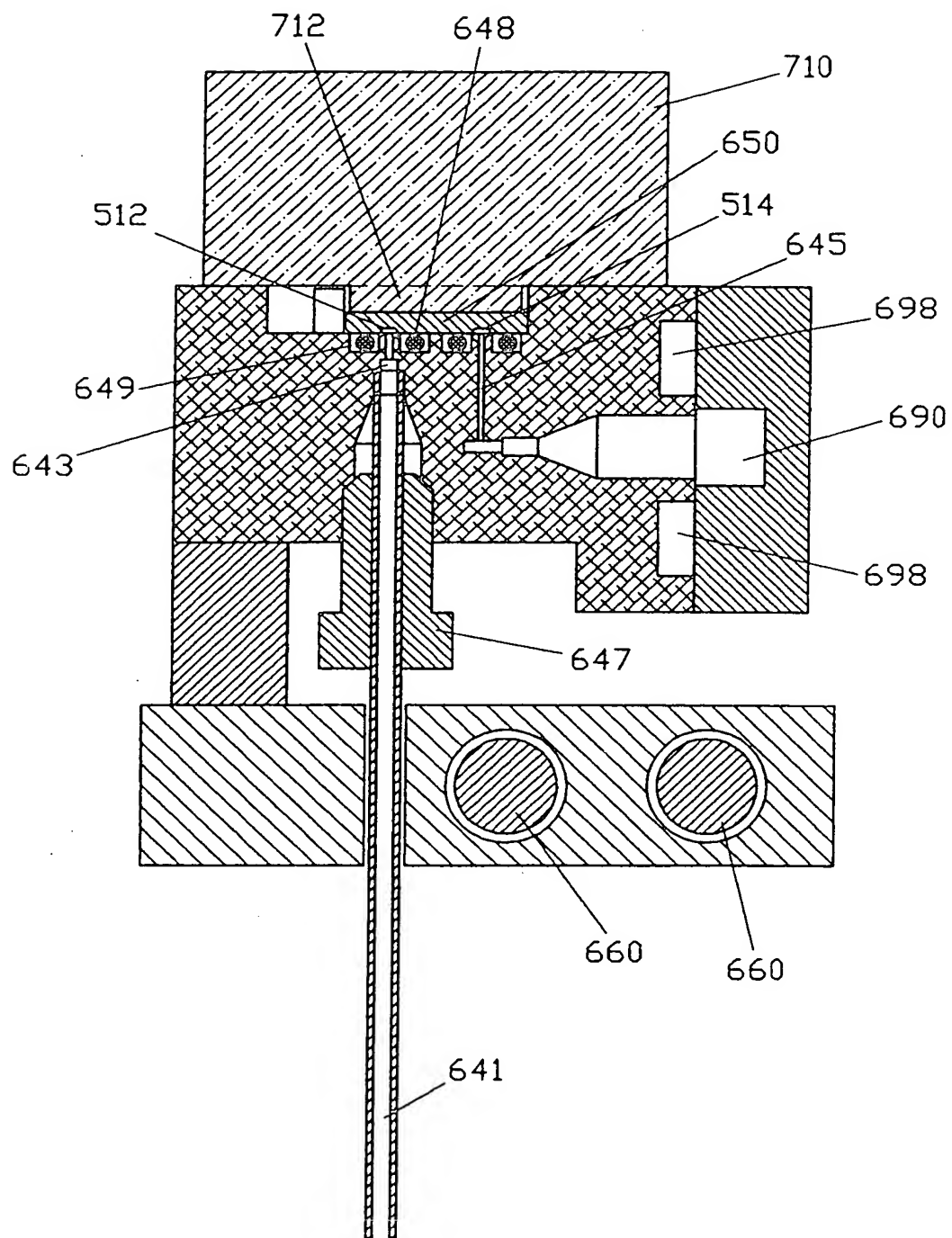
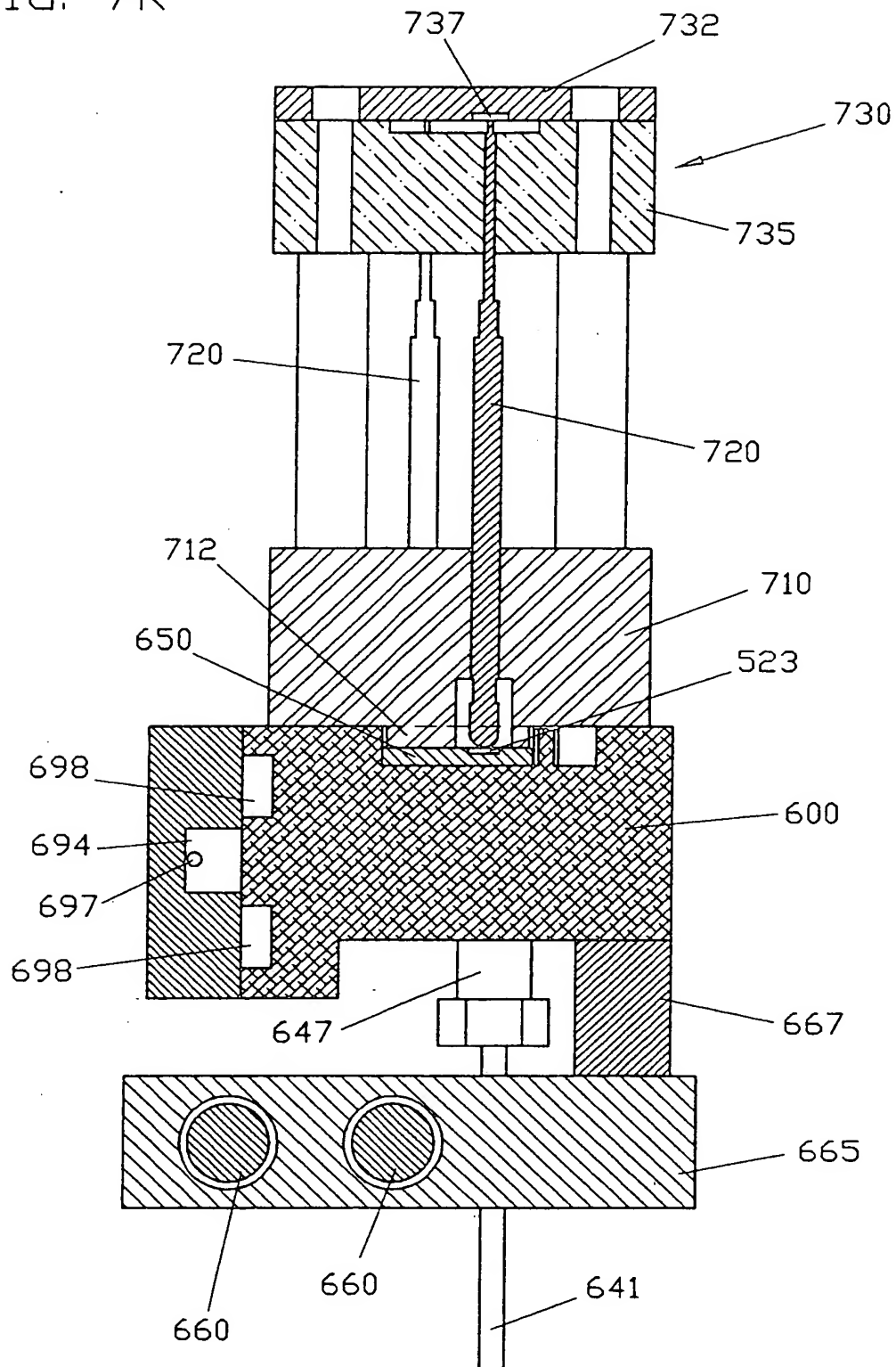
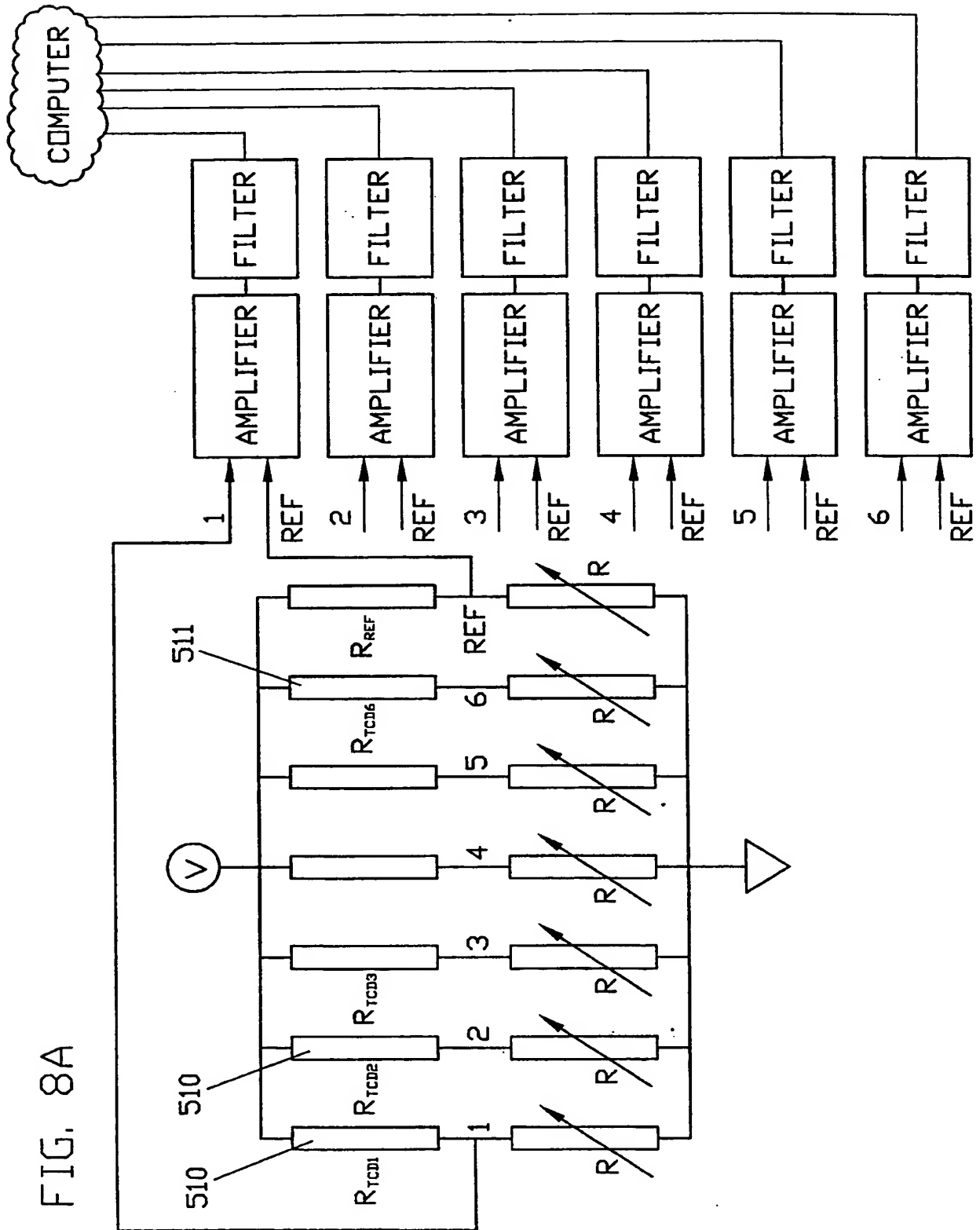


FIG. 7K





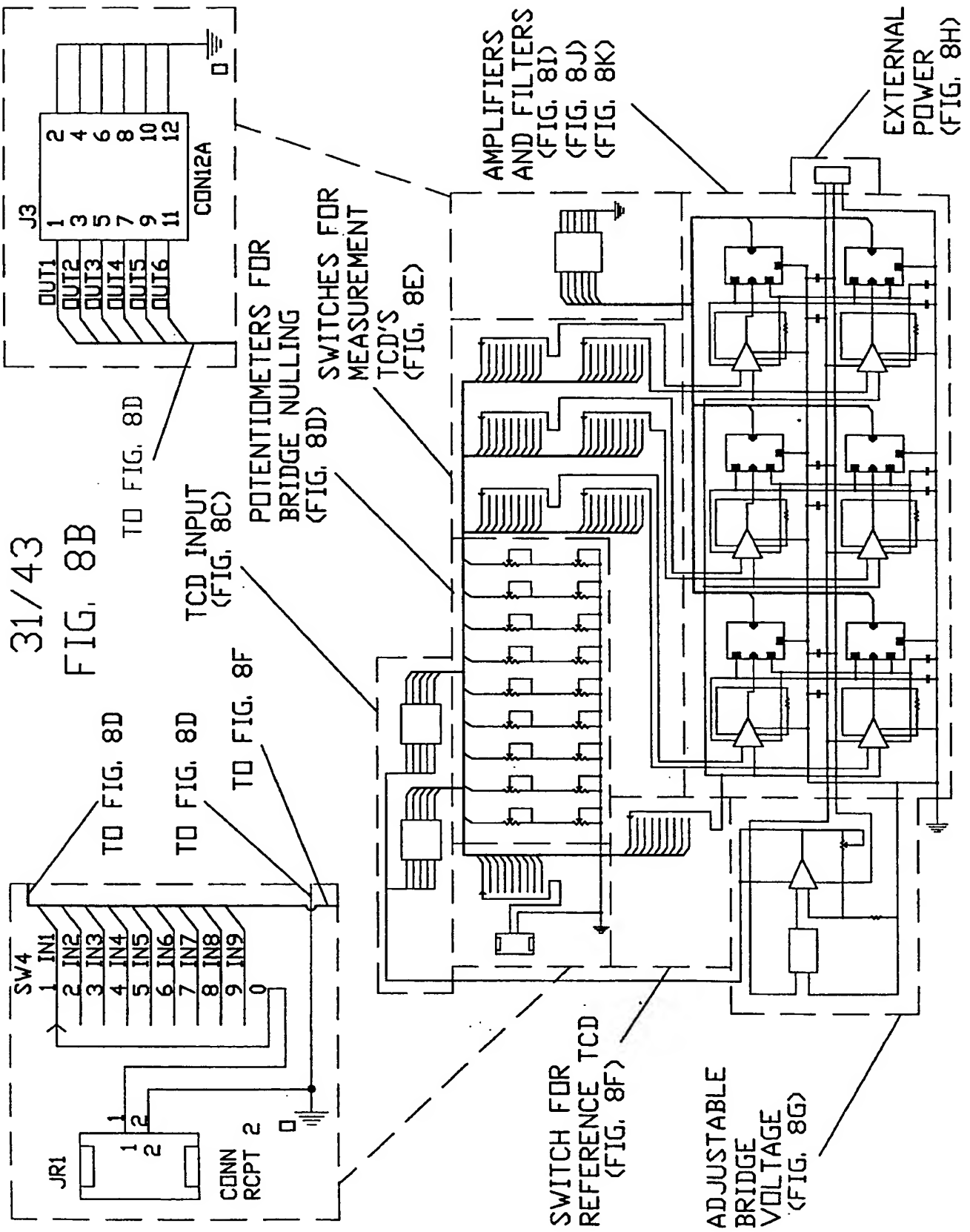


FIG. 8C

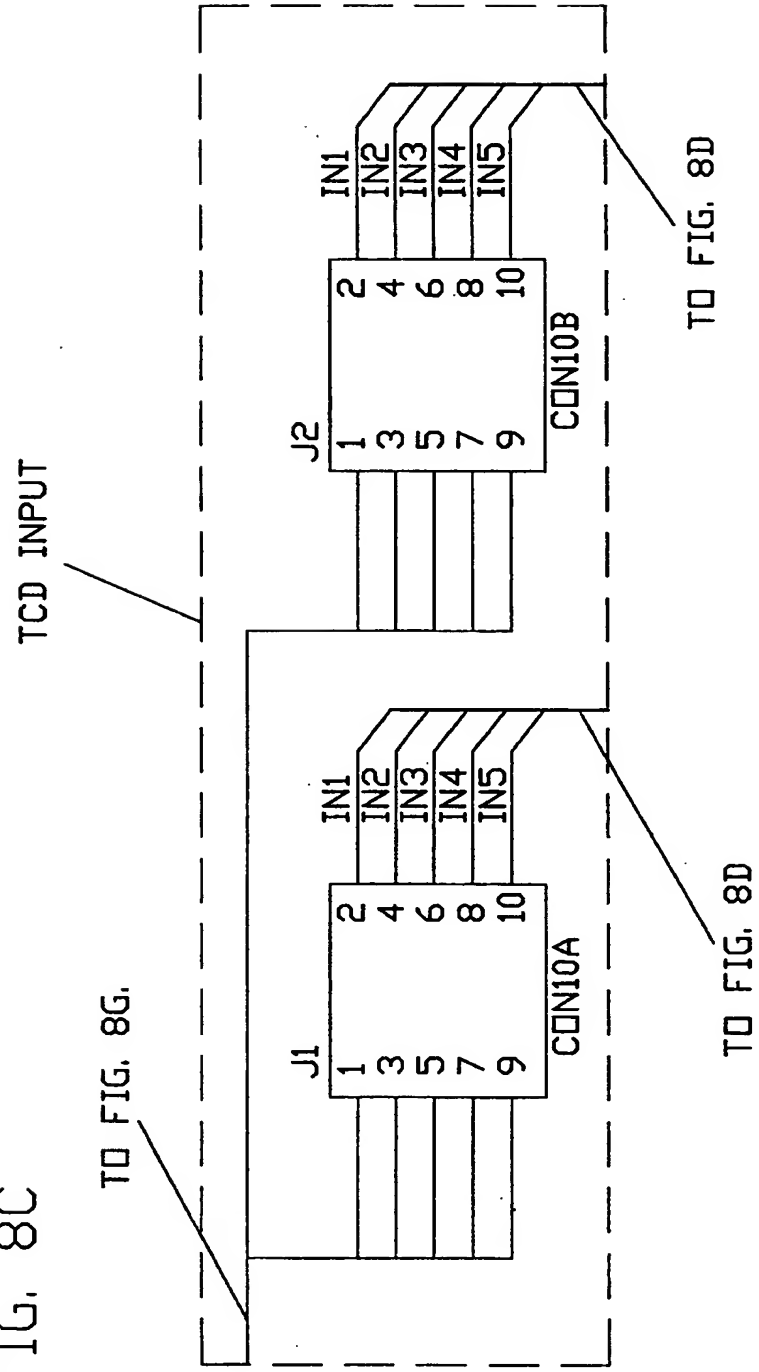
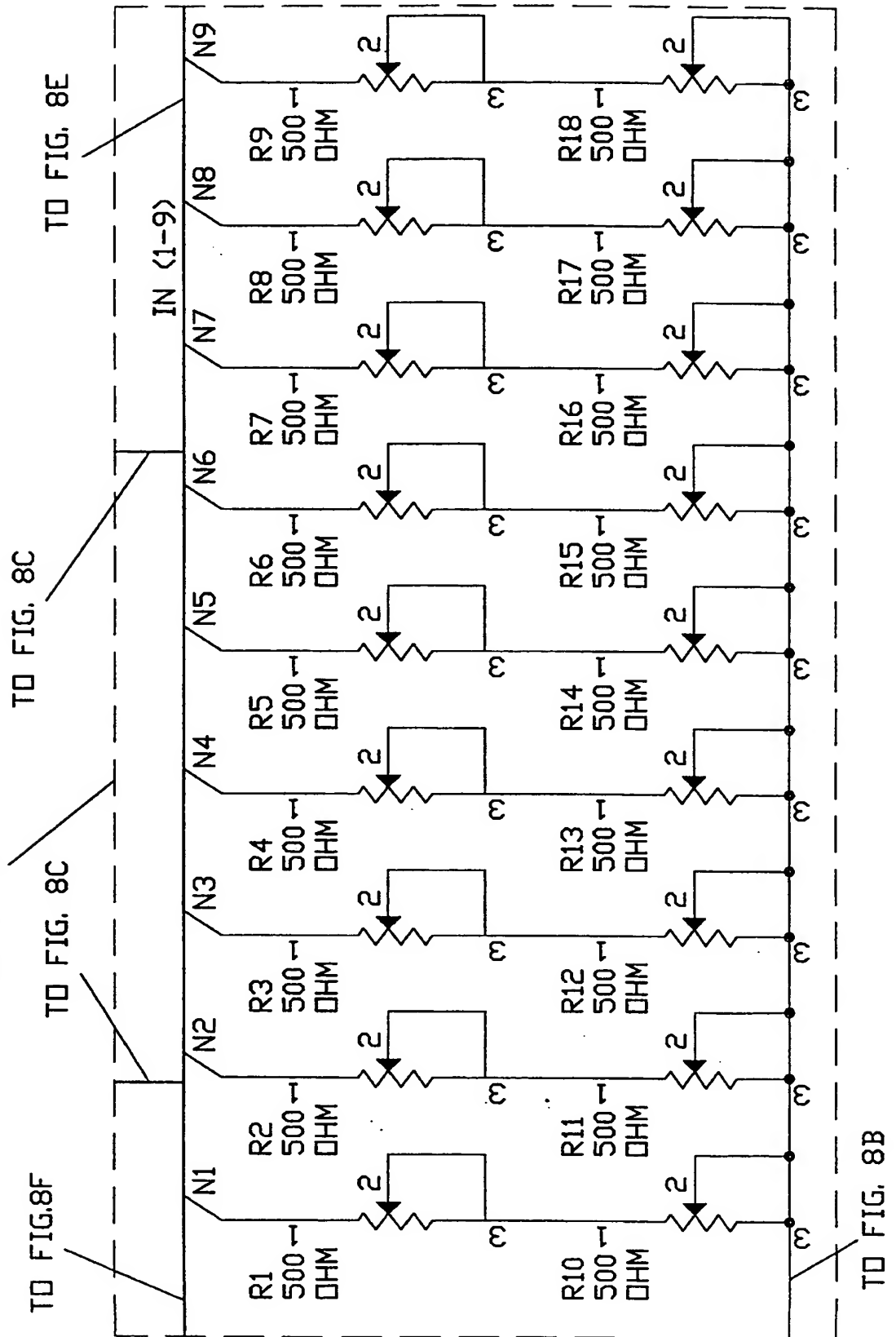




FIG. 8D

POTENTIOMETERS FOR  
BRIDGE NULLING

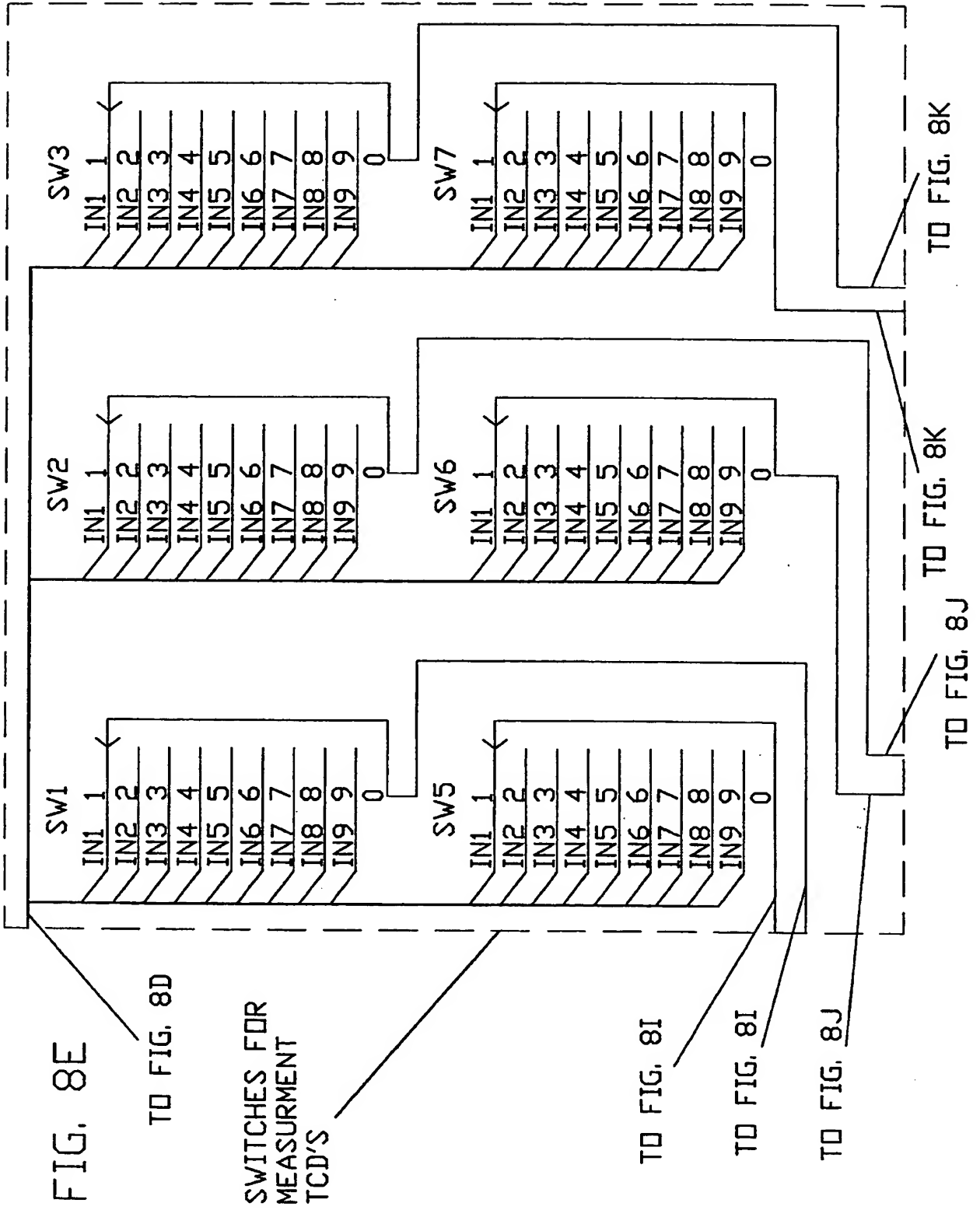
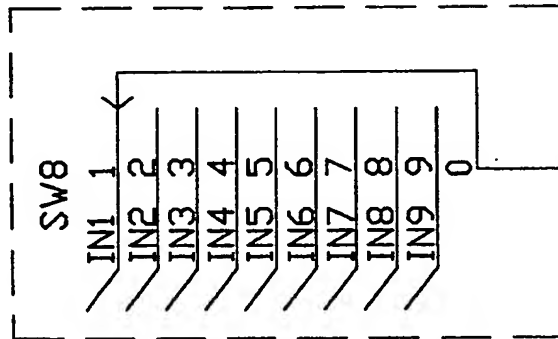


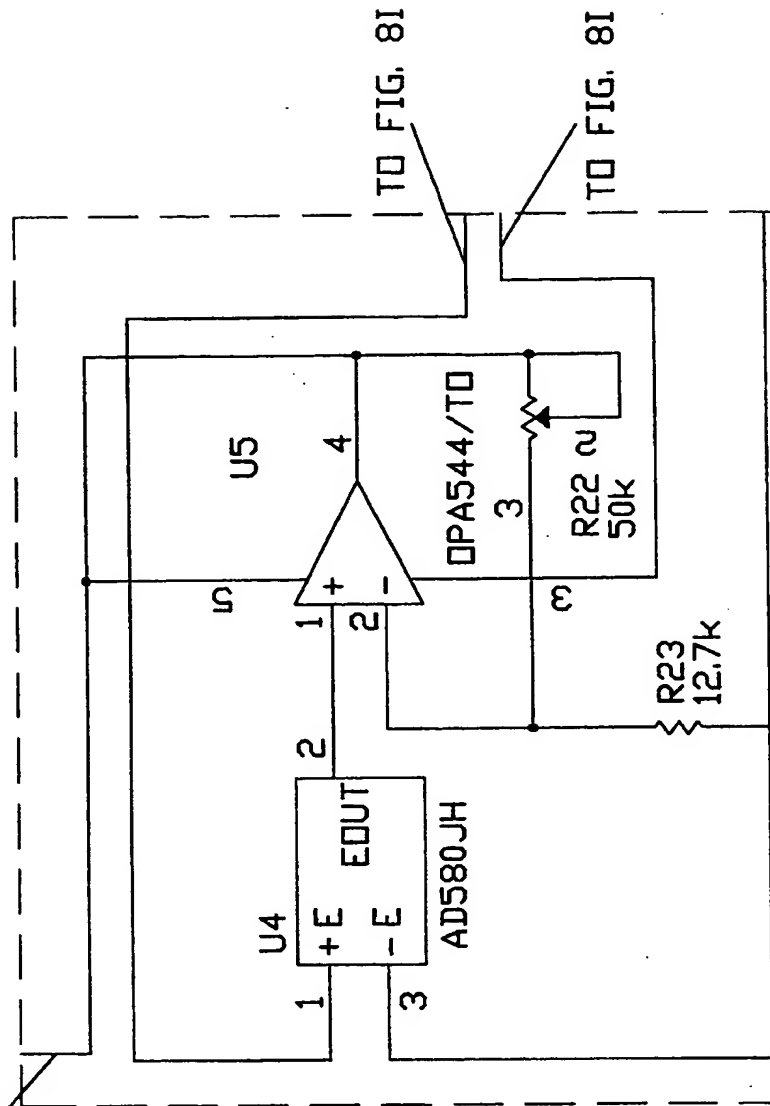
FIG. 8F



SWITCH FOR  
REFERENCE TCD

TO FIG. 8C

FIG. 8G



TO FIG. 8I

TO FIG. 8I

TO FIG. 8K

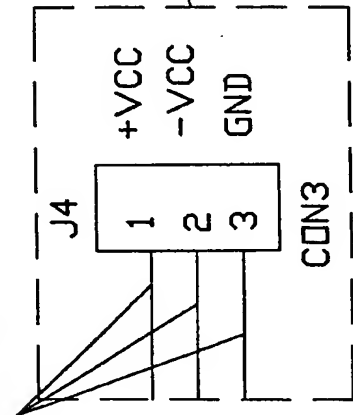


FIG. 8H

EXTERNAL  
POWER

ADJUSTABLE BRIDGE VOLTAGE

FIG. 8I

TO FIG. 8F

TO FIG. 8E

AMPLIFIERS AND FILTERS

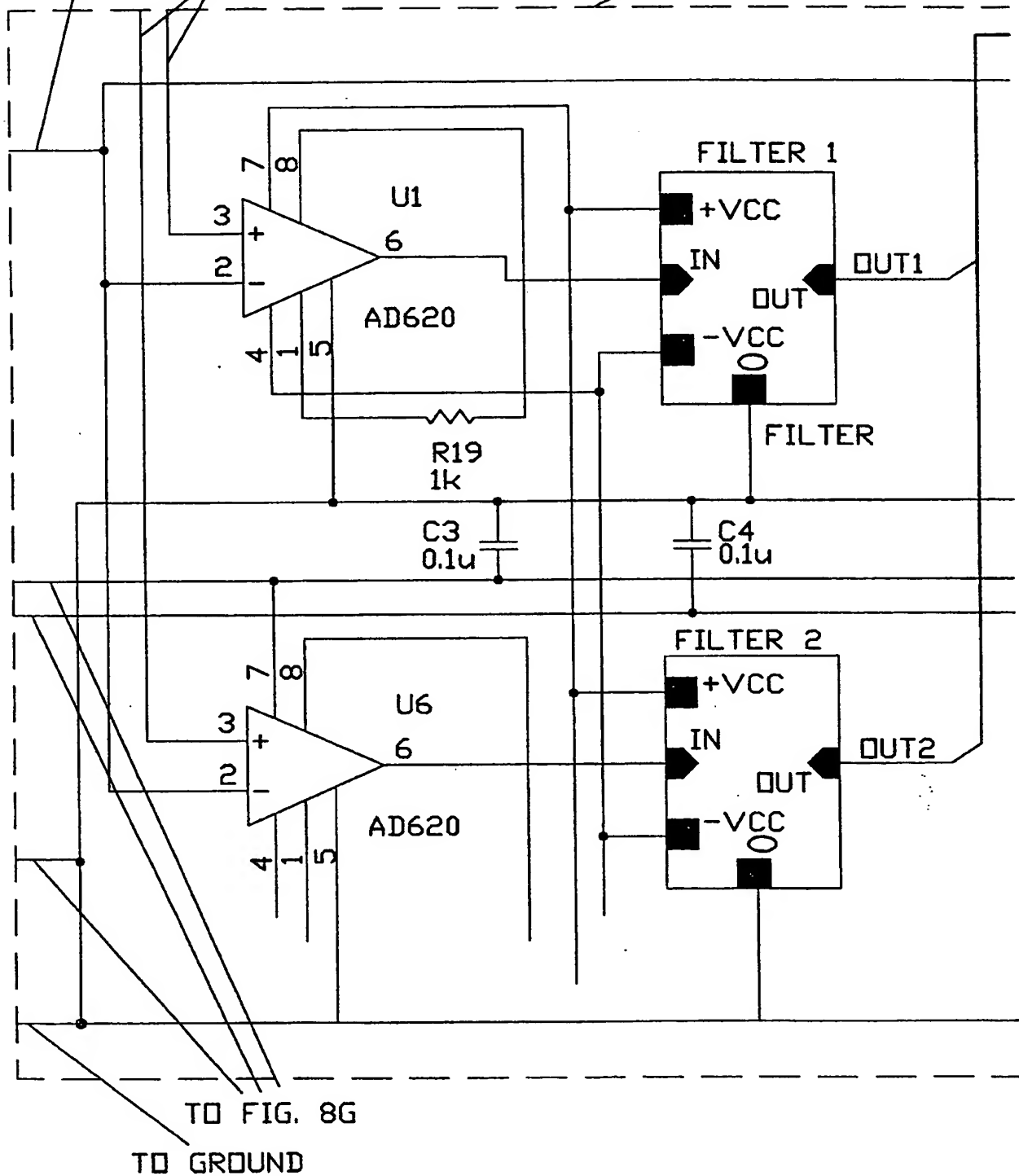


FIG. 8J

## AMPLIFIERS AND FILTERS

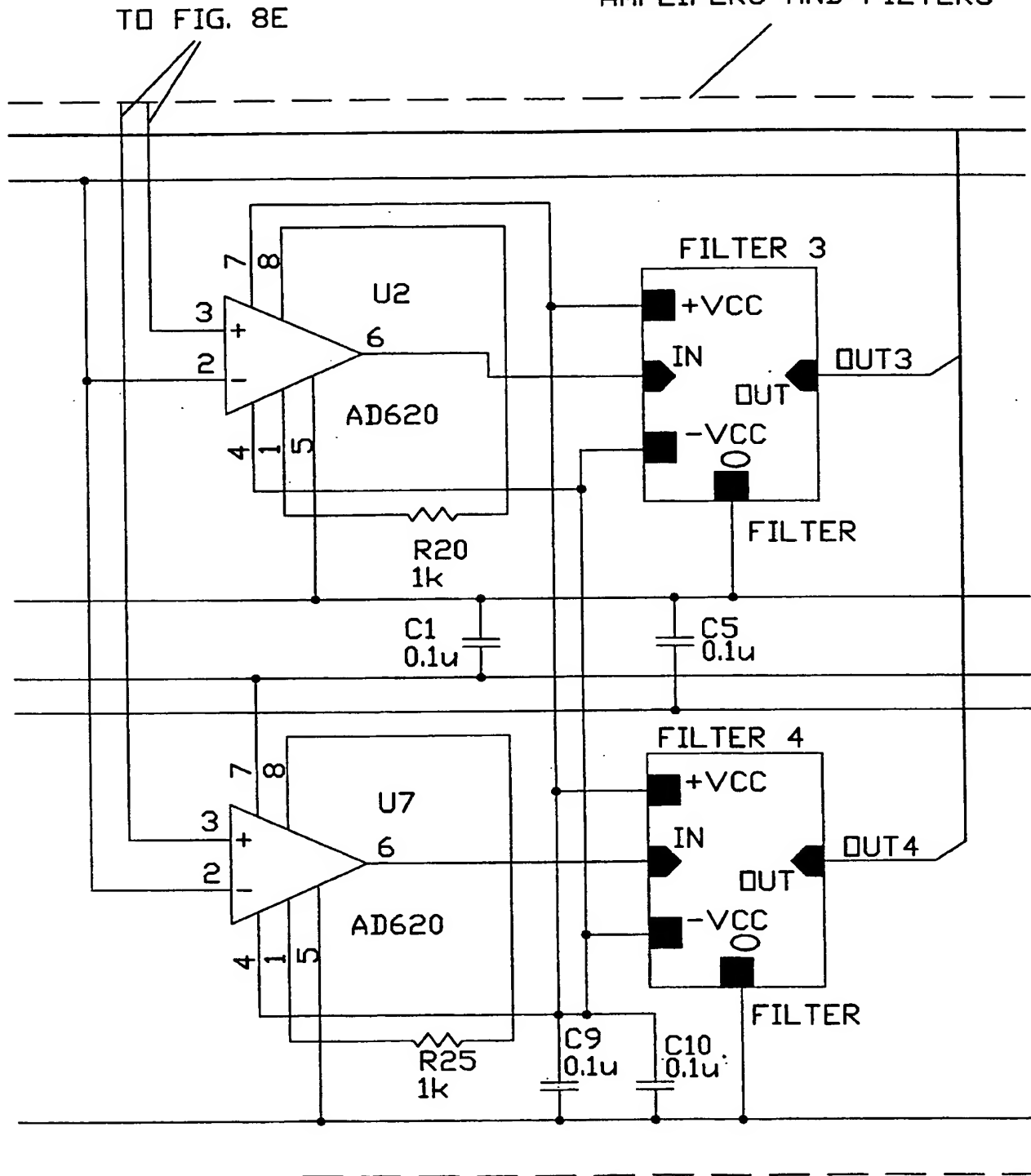
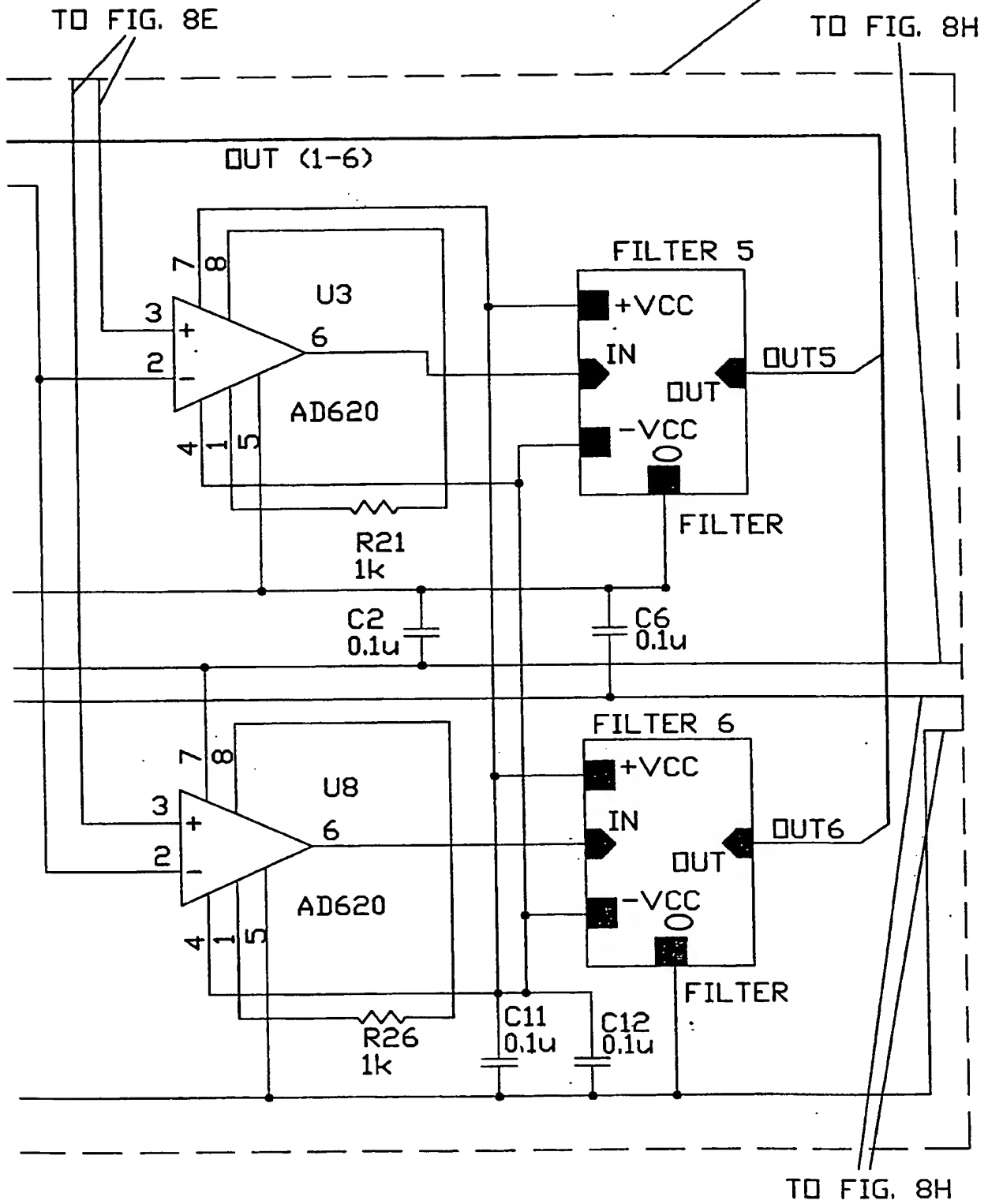


FIG. 8K

## AMPLIFIERS AND FILTERS



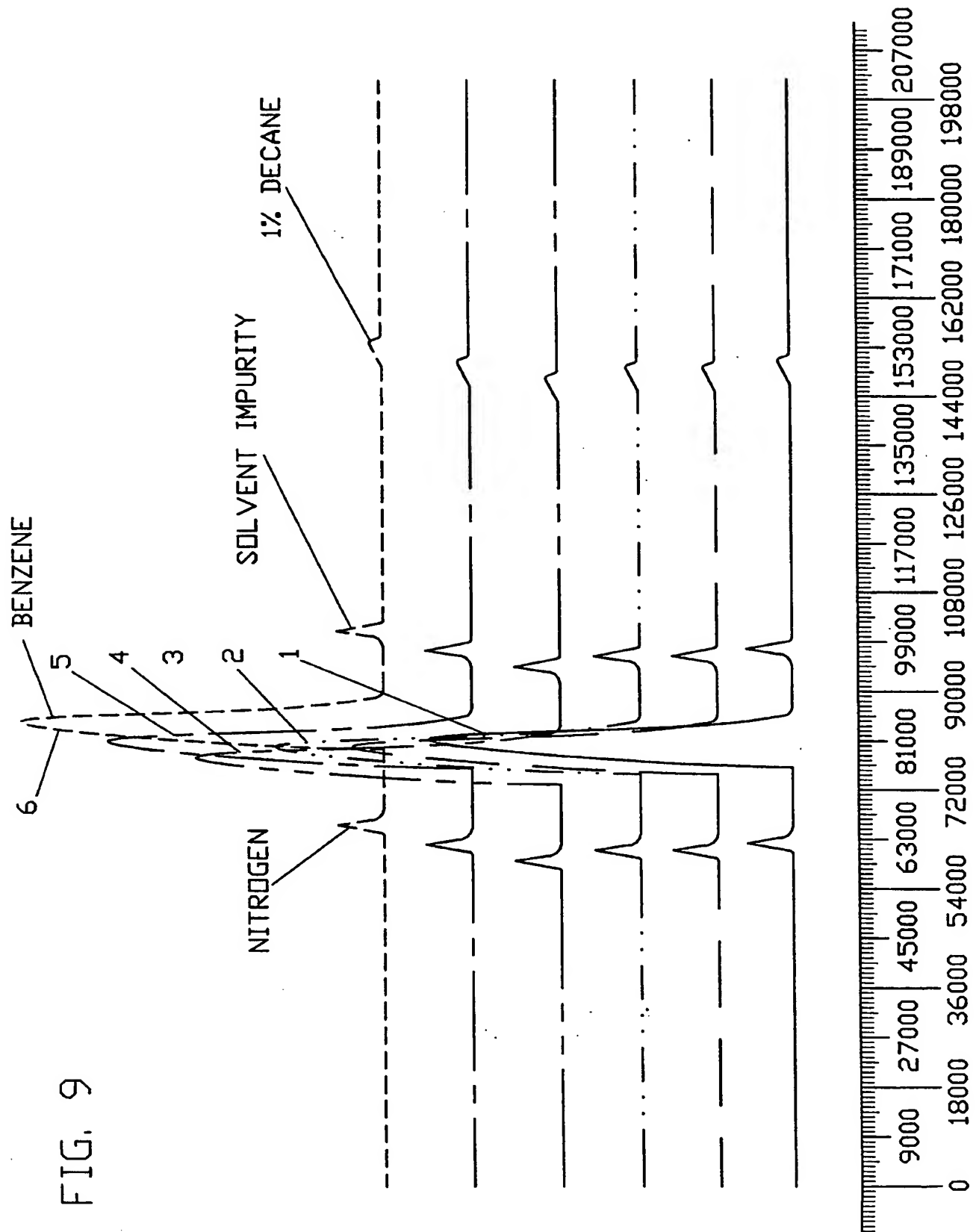


FIG. 10A

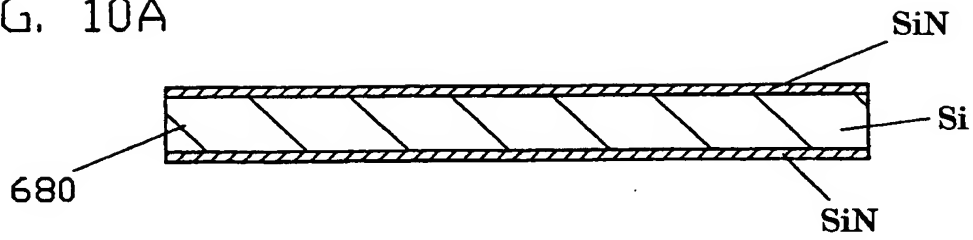


FIG. 10A

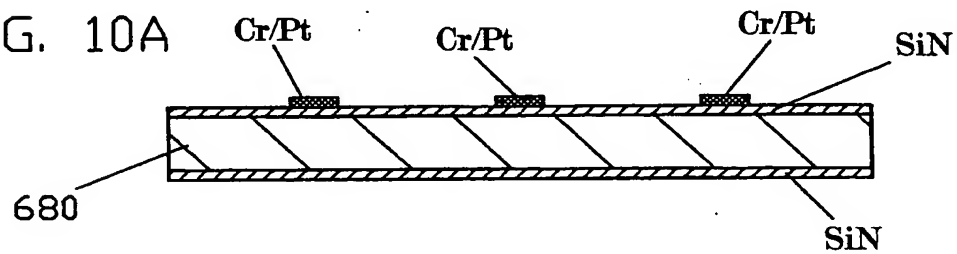


FIG. 10C

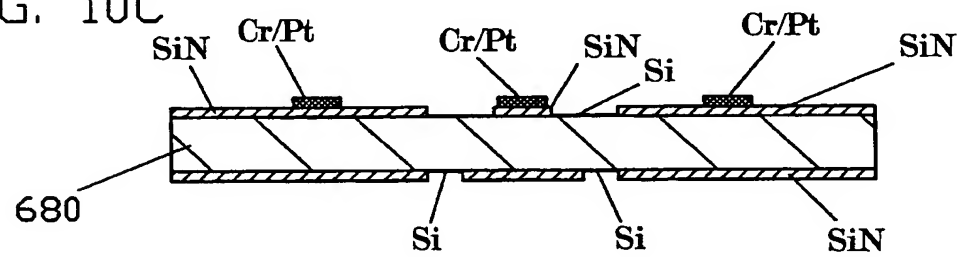


FIG. 10D

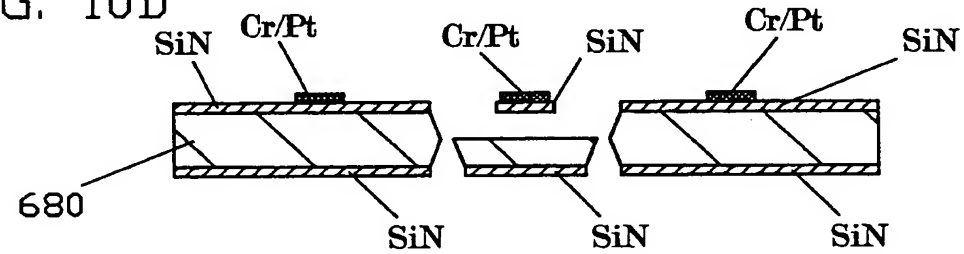
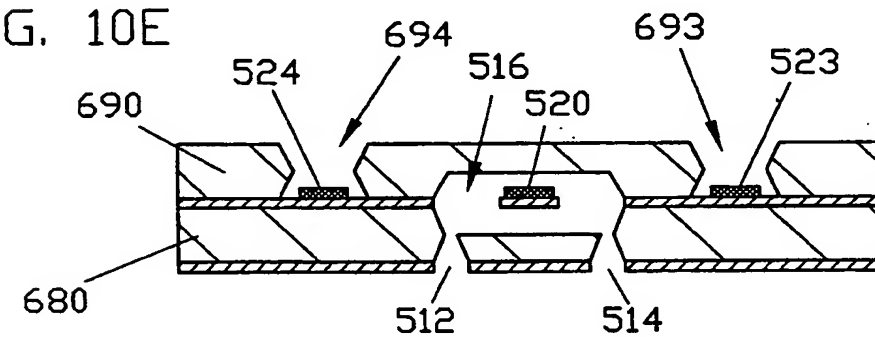


FIG. 10E





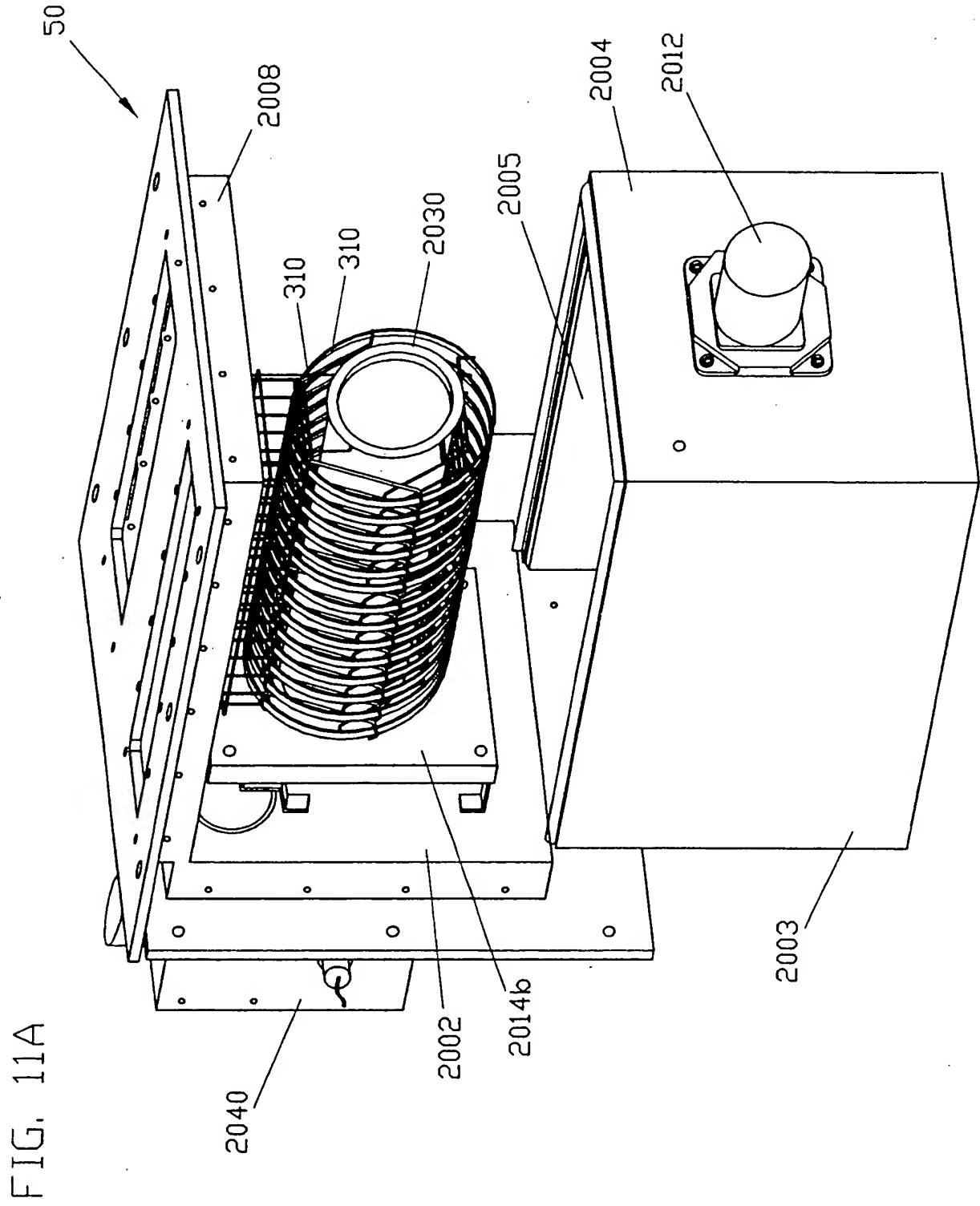


FIG. 11B

